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THE INSECTS OF PUERTO RICO

By *George N. Wolcott*

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THE INSECTS OF PUERTO RICO

By GEORGE N. WOLCOTT

"IN fourteen hundred and ninety-two,
Columbus sailed the ocean blue"

from Spain, westward from the Canary Islands out into the unexplored Atlantic. His first landfall, instead of being one of the expected spice islands of the East Indies, or some outlying representative of the ages-old and highly developed civilization of India or China, proved to be merely one of the smaller islands of the Bahamas, with only big-eyed, bronze-colored, naked Tainos as its human inhabitants. Returning the next year, at the peak of his temporal power and glory at the head of a fleet of seventeen ships, Columbus discovered the islands of the West Indies which bound the east and north of the Caribbean Sea. On this second voyage, when only twenty-one days out from Gomera of the Canary Islands, the grand fleet first sighted the steeply mountainous and forest-covered island of Dominica: one of the most southern of the Leeward Islands of the Lesser Antilles. Going ashore and taking posession for the Spanish Crown of Marie Galante, and really exploring Guadeloupe, Columbus passed the more northerly islands of Montserrate, Antigua, Nevis and St. Kitts in rapid succession, to land in St. Croix, and divide the fleet for exploring the "Eleven Thousand" Virgin Islands, of which forty-six were actually counted.

On the 18th of November, 1493, Columbus discovered Vieques, and all day on the 19th his fleet sailed westward along the southern coast of Borinquen, which the Admiral named San Juan Bautista, landing on the 20th on the west coast. Shore parties of sailors ate seagrapes, presumably from much larger trees than the low bushes that now line Puerto Rican beaches. How difficult to reconstruct that pre-Columbian Puerto Rico, with no irrigated fields of sugar-cane, no coconut palms, no grapefruit or coffee groves, no pomarrosa thickets, no mangoes, no flamboyán or tulipán to flaunt their masses of brilliant blossoms in the tropical sunshine, so oppressive to the Spanish sailors warmly clothed in woolen garments and mail! The mangroves along the shores were trees, not pollared bushes; with no terrestial animal present (except man) larger than bats and rodents, the grasses of the savannahs of the south coast grew high among the almácigos and ceibas,

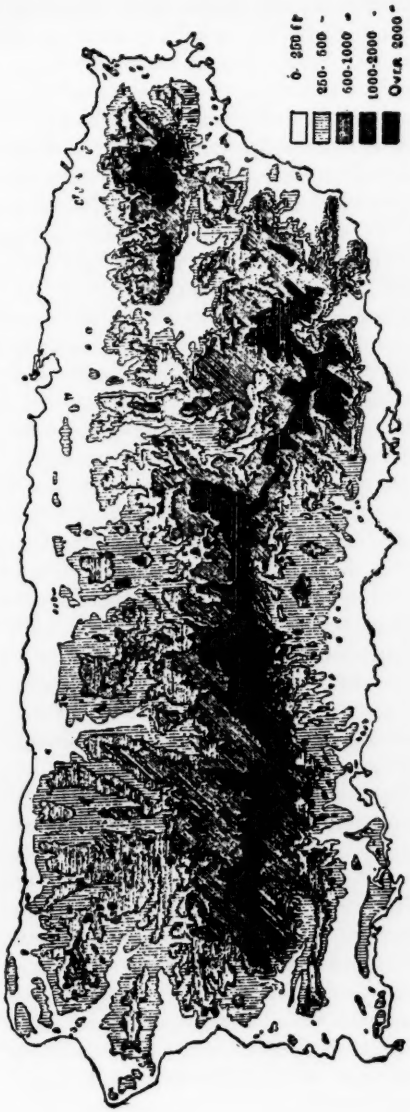
while massive trees of lignum-vitae, fustic, torchwood, cóbana negra, maga, úcar, algarrobo, moralón, ortegón and mahogany occupied level (agricultural) land, as well as the lower slopes of the densely forested mountains.

On the morning of the 22nd, Columbus' fleet started across the Mona Passage, sighting en route what he later named the Island of Mona. After extensive explorations in Hispaniola and Cuba, and circumnavigating Jamaica, Mona was again visited by Columbus less than a year later, in September 1494, at which time a landing was made and plantations of manioc, with enormous tubers, noted.

All of the West Indies which Columbus discovered have a tropical climate, the Tropic of Cancer passing just north of Habana, Cuba. Thus, for a longer or shorter period in the summer, the sun casts a southern shadow in these islands. Snow never falls on the peaks of the highest mountains, but the heat of the coastal lowlands is tempered by the prevailing northeast trade winds from the Atlantic. Typical of the West Indies also, are tropical hurricanes, one of which Columbus experienced: a constant threat in the late summer and autumn, when wind velocities may attain a speed of 150 miles per hour and cause enormous damage to vegetation and buildings.

While some of the myriad Virgin Islands are possibly most distant from the mainland, Puerto Rico is farthest removed of the larger islands. It is approximately a hundred miles long and forty wide, and so nearly rectangular in shape that it might well be used on maps, instead of the State of Pennsylvania, to give scale for comparison of size. Except for limited areas of mangrove swamps and rocky cliffs, most of the coast of Puerto Rico is a broad beach of shining yellow sand. A fringe of seagrape or coconut groves separates it from the meadows of dairy farms or the almost unbroken fields of sugar-cane which today occupy most of the more fertile land along the coast and extend up the stream valleys for a few miles into the mountainous interior.

Most of the island was wooded at the time of its discovery by Columbus, for the resident Indians lived mostly by fishing, and their settelments along the coast were surrounded by very limited cleared areas of corn, yuca, yams, cotton and tobacco under cultivation. Forests of a sort still cover a large part of Puerto Rico, but most of these are artificial forests: coconut groves along the coast, citrus groves a little farther inland on sandy areas along the north coast, and trees of coffee and their accompanying shade trees in the central and western portions of the Island. On the more level land of the interior, pineapples and tobacco are the principal commercial cultivated crops grown, but one sometimes sees land being plowed so steep that the feet of one ox of the yoke are level with the horns of his mate. We can have little conception of the magnificent character of the virgin forests of the coastal region of Puerto Rico, for all that remains are rocky areas of



PHYSIOGRAPHIC MAP OF PUERTO RICO

scrub in the arid southwestern corner of the Island, from which all marketable trees of lignum-vitae, fustic and mahogany were culled long ago. In the interior, the remaining natural forested areas are in the more rugged mountainous regions, until recently so remote from roads that dragging out the most valuable timber was impractical. Because no individual could exploit them, these areas remained in the posession of the government, to be later designated as national forests and only at the present time made accessible by roads. Part of the interior of Puerto Rico has been cleared of forest for planting of subsistence crops, and later often allowed to grow up to little cared-for pasture, with guava bushes and high, unpalatable weeds gradually crowding out the cattle.

The moisture-laden northeast trade winds bring an abundance of rainfall to Puerto Rico, and as the highest intercepting mountains are close to the southern coast, the rainfall is well distributed over most of the Island. Economically and agriculturally, however, the arid to semi-arid southern coast is of the greatest importance, constituting the most extensive area of level land devoted to cane-growing, and here are located the largest mills for grinding sugar-cane. By constructing reservoirs north of the main mountain range, water can be collected for irrigating the level coast south of the mountain ridge. Rainfall averages less than 30 inches in a year along the south coast, and may be less than 20 inches at the southwestern corner of the Island. As this mostly comes in the spring, a sudden profusion of leaf and bloom in the unirrigated areas, accompanied by bird and insect life, replaces the barren, sunbaked brown desolation of most of the rest of the year. The contrast is in the tropical rain (or hurricane) forests of the Luquillo mountains of northeastern Puerto Rico, the summits of which are almost continually wreathed in clouds and subject to sudden downpours of rain that total over 100 inches in a year.

To the west of Puerto Rico, about half way to Hispaniola, is Mona Island, a high, level table-land, almost uninhabited by man and less cultivated by him than at the time of Columbus, with a narrow sandy beach for landing by boat or plane on its western edge. The climate of Mona is similar to that of southwestern Puerto Rico, and its desert scrub vegetation, thinned by innumerable wild goats and pigs, supports much the same kind of insect life, but plus some abundant species not found on the larger island. Officially and for the purposes of administration, Mona is considered as part of Puerto Rico, as is also the small, rough, precipitous and entirely uninhabited Desecheo off the northwestern corner of Puerto Rico. To the east of Puerto Rico are several rocks and minor islands, and Culebra and Vieques. Culebra and Vieques are both of considerable size, reasonably level, and in considerable part agriculturally exploitable despite a scarcity of rainfall. Their climate and natural vegetation are so similar to that of

eastern Puerto Rico that no insects not occurring in Puerto Rico have been found on them.

Except for raids on settlements by pirates, and attacks by the English and Dutch on San Juan, Puerto Rico has been at all times continuously under the Spanish flag from the time of its discovery by Columbus up to its occupation during the Spanish-American war by troops of the United States Army. Of the naturalists who became famous for their observations and collections in other islands of the West Indies and elsewhere in tropical America during this period, Puerto Rico appears to have attracted less than a fair proportion. The earliest recorded collection of insects in Puerto Rico was made by the Botanist, André Pierre Ledrú, and is reported in his "Viaje a la Isla de Puerto Rico en el Año 1797", Paris 1810. Of the forty-six insects listed under their scientific names, ten can be readily identified and one can guess at the identity of many of the others. But none of these, it should be noted, was described from Puerto Rico as new: all were old, previously described species, widely distributed elsewhere in tropical America.

A collector for the Royal Zoological Museum in Berlin, Herr C. Moritz, as recorded in his "Notizen zur Fauna der Insel Puertorico" (Wiegmann's Archiv für Naturgeschichte, **2**: 373-392. Berlin, 1836), coming from the Danish islands of St. Thomas and St. John, landed at Arecibo on February 17, 1835, in an open boat on the beach, where he noted Cicindelids (presumably *Cicindela trifasciata* F.) and small Carabids "umherschwärmten." Riding "nach der dort eigenthümlichen Art auf Körben", he passed thru "mit Tabackspflanzungen umgebene" Manatí en route to San Juan. He started across the Island to Caguas "von der hier als Augengift verschrieenen *Volkameria fragrans* durchduftet," passed the hot springs of Coamo to Ponce "mit weiten üppigen Zuckerfeldern," and thence proceeded to Guayama and Yabucoa, where he made his "Aufenthalspunkte" for several months.

His account, written at Caracas, Venezuela, in January 1836, apparently was prepared before determinations of the insect material sent to Germany had been received. In consequence, many of the insects which he observed are identified no more exactly than by comparison with European forms, of others only the genus is listed, but a few of his identifications are entirely correct. We can be certain of the identity of nine butterflies, and guess at that of several others. Of some insects, his descriptions of appearance, host and habits makes identification reasonably certain. For the more conspicuous larger animals, birds, plants and trees, Herr Moritz uses local names, and also for a few insects, such as "cucubano" and "comehen."

The organization of his material might be called romantic ecological, the

final purple passage of environmental description coming to a climax with the record of a whirligig beetle, the olive-green *Gyrinus longimanus*, which Herr Moritz incorrectly states also occurs in Patagonia. (Olivier originally described *Dineutes longimanus* from Cuba, and its known distribution outside of the Greater Antilles extends only to Costa Rica.) His romantic point of view excludes from consideration the local development of agriculture, for the only additional mention of crops is of corn growing in clearings in the woods. The clusters of mountain palms and royal palms (the latter called "kohlpalm" and not "palma real" by Herr Moritz, in this case surprisingly insensitive to the lack of esthetic implications of the cabbage), the moist grassy banks of streams in the shade of bamboos, the wild, grass-grown "poyales" (quite different in his day from the poorly-drained cane fields of the present) and the coming of twilight illuminated by the flashes of light from five kinds of Lampyrids and the "cucubano" are described minutely and with feeling, only to be followed by prosaic lists of the insects, especially beetles, which he found present.

In this collector's paradise, admittedly there are "Niguas (*Pulex penetrans*), die Musquitos (*Culex fasciatus et al. sp.*), Sandfliegen (*Simulia*), kaum grösser als ein Sandkorn, die grösste Stechfliege (*Chrysops*), dagegen sah ich keinen *Tabanus*". After emphasizing the absence of poisonous snakes in Puerto Rico, Herr Moritz has much to say of the smaller poisonous animals, being especially impressed with the size of the "Guavá, Krabbenspinne (*Phrynus reniformis* Latr.)," which he measured with care. "Der Biss der Guavá soll für Menschen tödtlich sein, den grössern Vich wenigstens unheilbare Beulen verursachen, wie ich sie bei Pferden, von der Grösse eines Menschenkopfs, am Bauche herabhangen sah." The local tarantula he found living "stets in Baumhöhlen;" a centipede is listed correctly as *Scolopendra morsitans*, with no comment on its habits. A millipede "bei Berührung einen ätzenden, die zarte Haut entzündenden Saft, der dem Auge selbst Blindheit verursachen soll, von sich spritzen." Aside from this, however, he describes only a bountiful Nature, "von deren Erzeugnissen man hat bisher noch so wenig wusste," even the spider *Epeira argentata* F. having a beautiful web and silvery spots more permanent after death than those of the golden Cassid beetles on the leaves of *Convolvulus*, or the leaf-rolling Attelabid weevils on *Psodium pomiferum* (now called *Psidium guajava*), of whose "goldener Schulterfleck sich nach dem Tode in ein mattes Gelb verwandelt." In addition to cockroaches and mantids, a wingless nymphal walking-stick, (*Phasma*) was noted, of which he later in Venezuela found what he supposed to be its winged adult.

No mention is made of dry-wood termites, presumably rare in such an undeveloped country, but to the habits and destructiveness of "Comehens, *Termes fatalis* et al. sp.", building nests as large as "Bienenkörbe," half

a page is devoted. His references to Hemiptera are less exact, European names being given for the aquatic forms collected, cicadas and Cimicidae noted as attracted to light, and Lygaeids found on *Sida rufescens* and *Asclepias curassavica*. In addition to listing genera of beetles found at light and in various environments, Herr Moritz records finding on "Oenotheren" (now called *Jussiaea angustifolia*) the "ansehnliche dunkelblaue in Violet spielende" Chrysomelid beetles of *Galerucella* (now *Altica* or *Haltica*) *Jamaicensis* F. He identifies correctly *Hololepta 4-dentata* F. under the leaf-sheaths of fallen palms, and finds *Calandra sericea* (=*Metamasius hemipterus* L.) larvae feeding on the pith, and "zur Verwandelung in ein dichtes Knäuel von Blattfasern sich einhüllt." He noted a little black and white curculio on *Solanum torvum* which had already been described by Olivier in 1807 under the name *Rhynchaeus* (now called a *Baris*) *torquatus*, the type from Puerto Rico.

The famous Cuban naturalist, Dr. Juan Gundlach (born in Germany, and christened Johannes Christopher Gundlach, see the biography by Charles T. Ramsden in "Entomological News", **26** (6): 241–260, pl. 2, Philadelphia, June 1915), urged by the German vice-consul Herr D. Leopoldo Krug, representative of the firm Lemeyer y Cia., in Mayagüez, came to Puerto Rico in 1873, and together they collected in the western end of the Island. In 1875, Gundlach made a second trip to Puerto Rico, this time as the guest of Dr. Augustín Stahl, with whom he collected in the Bayamón region. In 1881, Gundlach made a third and final trip to the Island. The collections he had made with Krug and Stahl were sent to Berlin, where they were studied, classified and many new species described by various specialists. Between May 1887 and September 1893, Gundlach published the sections dealing with insects of his "Fauna Puerto-Riqueña" in the Anales de la Sociedad Española de Historia Natural, Madrid, embodying the results of his collections and studies. This paper will remain a lasting monument to his energy, perseverance and industry in advancing systematic entomology in Puerto Rico. As he was the old-fashioned, unspecialized type of naturalist, interested in all phases of the specimens he collected, his notes also include records of host plants observed, especially if these were of economic value.

By comparison with the relative aridity of investigations in natural history or any other science (excepting only those of C. W. Morse in the electric telegraph when he was living near Arroyo) in Puerto Rico during the centuries when it was under Spanish rule, the promptness and energy with which all sorts of such projects were initiated after the change in government in 1898 forms a most striking contrast. The U. S. Fish Commission sent the U. S. S. "Fish Hawk" for two months (January–February 1899) to investigate the marine life around Puerto Rico, and on board was a repre-

sentative of the Division of Entomology: Mr. Aug. Busck. He had been directed to collect especially scale insects, as only one previous record was known from Puerto Rico, as well as to make observations on the insects of economic importance, such as the "changa". He returned to Washington having collected 800 to 900 species of insects, some of which have not been described until recently, as well as many spiders and myriapods.

In May 1901, Mr. D. W. May, representing the U. S. Department of Agriculture, established an experiment station at Rio Piedras, which in September 1902 was transferred to its permanent location at Mayagüez. The early reports of its first Entomologist and Botanist, Mr. O. W. Barrett, concern especially the changa, and the coffee leaf-miner, of which he was the first to discover the minute parasitic wasps attacking the caterpillar.

This early period of the American occupation was one of material progress and change in many directions. The railroad from San Juan around the Island to Ponce and Guayama was completed; Mayagüez had a street-car system powered by Edison's newest and largest electric storage batteries; and Ponce a Stone and Webster system where recent graduates of M. I. T. could test in practise the theory they had learned in college. Mr. Pat McClain of Central Aguirre demonstrated such progress in cane-production that "mcclain" as a unit of cultivation became an essential part of the Puerto Rican language. Both Guánica Centrale and Central Fajardo had experiment stations, and in 1910 the Sugar-Producers' Association established an agricultural experiment station at Rio Piedras devoted entirely to the problems of cane production. The Board of Commissioners of Agriculture established a plant quarantine service, and also employed entomologists supplementing those of the Rio Piedras Station. It was high tide in entomological research!

Dr. Wm. Morton Wheeler, just beginning to be known for his work on ants, in March 1906 had visited Puerto Rico and Culebra to collect "The Ants of Porto Rico and the Virgin Islands" (Bull. Amer. Mus. Nat. Hist., **24** (6): 117–158, fig. 4, pl. 2, New York, 1908), with a party in charge of the Director of the New York Botanical Garden, Prof. N. L. Britton. Dr. Britton himself made no direct contribution to entomology in Puerto Rico, but his systematic botany of the Island, based on numerous extensive collecting trips, published in later years by the New York Academy of Sciences as parts of the "Scientific Survey of Porto Rico and the Virgin Islands", is of the greatest value to every working entomologist by enabling him to identify and name the specific host plants attacked by insects. Collections of insects by H. G. Barber, H. E. Crampton, F. E. Lutz, A. J. Mutchler and F. E. Watson, of the American Museum of Natural History, in Puerto Rico, and by Dr. F. E. Lutz in Desecheo and Mona were made on expeditions to these islands in connection with the Survey. Some pub-

lished numbers of the "Survey" deal with various orders of insects. They are of widely varying character: some are well illustrated, others not at all; some are by specialists who never visited the Island, others did their own collecting and knew Puerto Rico from personal experience.

Years before any of these "Survey" systematic entomological papers had even been planned, Mr. R. H. Van Zwaluwenburg, at the time he was Entomologist at the Mayagüez Station, prepared MS lists of all the identified insects in the collections of the two experiment stations. Based on these and Gundlach's paper, the writer compiled a more extensive annotated list, which, with a supplement, was later expanded to " 'Insectae Borinquenses', with a host-plant index by José I. Otero", (Jour. Agr. Univ. P. R., **20** (1): 1–627, illus., Río Piedras, July 10, 1936), of which a supplement appeared in 1941.

Rather than attempt a new list at the present time, including the rather considerable amount of new records that has since been accumulated, especially those in Prof. J. A. Ramos' master's thesis "The Insects of Mona Island, West Indies" (Jour. Agr. U. P. R., **30** (1): 1–74, pl. **2**, ref. 45. Río Piedras, 1947) it seems more desirable by presentation in what it is hoped will prove to be a simplified form, to remedy some of the complications in attempting to use all of this material. The name of every recorded insect is given, but not the confusing mass of accession numbers of the collection at the Rio Piedras Station and of the interception numbers of the Federal Plant Quarantine Service of the San Juan Office of the Bureau of Entomology and Plant Quarantine, and locality records, unless especially pertinent, are generalized to biologic regions. It should be especially noted, however, that whereas ordinary entomologists collect insects, the Plant Quarantine Inspectors invariably "intercept" their insect material, and this distinction is observed in the following pages.

For convenience, the more pertinent data concerning the professional resident and some of the visiting entomologists are here presented in semitabular form. The only amateur to be noted is the clever, gifted, but erratic Cesário Pérez, who collected and reared butterfly caterpillars in Río Piedras and Arecibo regions, 1939–40.

C. G. Anderson (Plant Pathologist), Federal Plant Quarantine at San Juan, 1930–36.
B. A. App, Federal Station at Mayagüez, 1935–36.
J. W. Balock, Bureau of Entomology, at Mayagüez, 1935–36.
O. W. Barrett, Federal Station at Mayagüez, 1903–05.
Kenneth A. Bartlett, Federal Station at Mayagüez, 1935–.
N. O. Berry, Federal Plant Quarantine at San Juan, 1931.
I. W. Berryhill, Federal Plant Quarantine at San Juan, 1937–39.
Harold E. Box, Central Aguirre Station at Aguirre, 1924–27.
Luis A. Catoni, Insular Plant Quarantine at San Juan, 1919–.
W. W. Chapman, Federal Plant Quarantine at San Juan, 1941–46.

C. E. Cooley, Federal Plant Quarantine at San Juan, 1925–28.
Richard T. Cotton, Insular Station at Rio Piedras, 1915–18.
R. A. Crespo, Insular Plant Quarantine at San Juan, 1918–19.
S. S. Crossman, Tobacco Insect Station at Aibonito, 1912–14.
Ralph E. Danforth (the father), College of Agriculture at Mayaguez, 1921–27.
Stuart T. Danforth (the son), College of Agriculture at Mayaguez, 1927–38.
Donald De Leon, Tropical Forest Experiment Station at Rio Piedras, 1940.
H. L. Dozier, Insular Station at Rio Piedras, 1924–25. Federal Station at Mayaguez, 1935–36.
G. L. Fawcett, Insular Plant Quarantine at Mayaguez, 1913–15.
Richard Faxon, Federal Plant Quarantine at San Juan, 1930–35.
L. Courtney Fife, Federal Station at Mayaguez, 1935–36.
Raymond J. Fiske, Insular Plant Quarantine at San Juan, 1913–14.
Herschell Fox, Federal Plant Quarantine at San Juan, 1927–28.
Irving Fox, University of Puerto Rico at Rio Piedras, 1941–42.
Sanitary Corps, U. S. Army, 1942–46.
School of Tropical Medicine at San Juan, 1946–.
Julio García-Díaz, University of Puerto Rico at Rio Piedras, 1927–.
Geraldus Gay, Federal Plant Quarantine at San Juan, 1925–28.
Mansel C. Guerry, Federal Plant Quarantine at San Juan, 1946–.
Wm. Hanson, South Coast Laboratory at Guánica, 1915–16.
A. G. Harley, Federal Plant Quarantine at Mayaguez, 1929–35.
Wm. A. Hoffman, School of Tropical Medicine at San Juan, 1926–43.
Charles W. Hooker, Federal Station at Mayaguez, 1910–12.
W. F. Jepson, Phytalus Investigation for Mauritius, at Cidra, 1933.
F. A. Johnston, Federal Plant Quarantine at San Juan, 1940–41.
Thos. H. Jones, Sugar Producers' Station at Rio Piedras, 1911–14.
Joseph Kline, Federal Plant Quarantine at San Juan, 1946–.
Mortimer D. Leonard, Insular Experiment Station at Rio Piedras, 1930–32.
L. C. McAlister, Jr., Bureau of Entomology at Mayaguez, 1934–35.
Louis J. McConnell, Federal Plant Quarantine at San Juan, 1941–46.
W. A. McCubbin (Plant Pathologist), Federal Plant Quarantine at San Juan, 1935–39.
A. H. Madden, Federal Station at Mayaguez, 1935–36.
Luis F. Martorell, Insular Station at Rio Piedras, 1936–.
G. B. Merrill, South Coast Laboratory at Guánica and Tobacco Insect Laboratory at Aibonito, 1913–15.
A. S. Mills, Federal Plant Quarantine at San Juan, 1929–37.
John D. More, Insular Station at Rio Piedras, 1920–23.
Harold Morrison, Bureau of Entomology, July 1917.
James G. Needham, University of Puerto Rico at Rio Piedras, 1935, 1939–40.
Edgar Nelson, Insular Station at Rio Piedras, 1918–19.
R. W. Nicaise, Federal Plant Quarantine at San Juan, 1928–30.
R. G. Oakley, Federal Plant Quarantine at Ponce, 1931–37.
Herbert Osborn (the father), Aguirre, 1929.
Herbert Osborn (the son), South P. R. and Central Aguirre Station at Aguirre, 1928–31.
W. T. Owrey, Federal Plant Quarantine at San Juan, 1935–40, 1946–.
Boyd Palmer, Polytechnic Institute at San Germán, 1918–.
Mario Pérez, Insular Station at Rio Piedras, 1948–.
G. A. Pfaffman, Federal Plant Quarantine at Mayaguez, 1937–40.
H. K. Plank, Federal Station at Mayaguez, 1935–.

Harry D. Pratt, Public Health Service at San Juan, 1941–46.
A. Earle Pritchard, Public Health Service at Losey Field, Salinas, 1941–42.
J. A. Ramos, College of Agriculture at Mayaguez, 1938–.
John W. F. Rehn, San Juan, 1949.
L. B. Scott, Federal Station at Mayaguez, 1935–36.
Francisco Seín, Jr., Insular Station at Rio Piedras, 1920–48.
M. R. Smith, Federal Station at Mayaguez, 1935–36.
R. G. Smith, Federal Plant Quarantine at San Juan, 1939–40.
E. G. Smyth, South Coast Laboratory at Guánica and Insular Station at Rio Piedras, 1913–20.
H. D. Tate, Federal Station at Mayaguez, 1935–36.
H. G. Taylor, Federal Plant Quarantine at San Juan, 1935–39.
W. V. Tower, Federal Station at Mayaguez, 1906–11 and 1917–23.
C. P. Trotter, Federal Plant Quarantine at San Juan, 1928–30.
G. S. Tulloch, Federal Station at Mayaguez, 1935–36.
S. H. Vandeburg, Federal Station at Mayaguez, 1935–36.
D. L. Van Dine, Sugar Producers' Station at Rio Piedras, 1910–14.
H. L. Van Volkenberg (Parasitologist), Federal Station at Mayaguez, 1926–37.
R. H. Van Zwaluwenburg, Federal Station at Mayaguez, 1913–17.
F. A. Vitrano, Federal Plant Quarantine at San Juan, 1946–.
F. M. Wadley, Federal Station at Mayaguez, 1935–36.
S. D. Whitlock, Federal Plant Quarantine at Mayaguez, 1925–29.
George N. Wolcott, Insular Station at Rio Piedras, 1912–16, 1921–24 and 1931–.
G. M. Young, Federal Plant Quarantine at San Juan, 1944–.

Because the major economic pests have been studied so much more intensively, we know more about them and to be at all complete, even a summary account must give them a disproportionate amount of space. Thus, altho in places this may appear to be an economic entomology, it is only so by accident. Its arrangement is systematic, rather than ecological by crops or animals attacked, and the insects of interest for any reason are discussed regardless of their being neither harmful nor beneficial to the interests of man. First comes a discussion of some insect-like arthropods which are not insects.

CRUSTACEA

Crustaceans are for the most part aquatic arthropods such as crabs, lobsters, shrimps and sowbugs which breathe by means of gills, rather than thru tracheae as do insects, and they have two pairs of antennae instead of the single pair possessed by insects. The smallest crustaceans, often minute in size, which have no abdominal appendages are the Entomostracha, almost entirely marine forms. The one most easily observed in Puerto Rico is the cosmopolitan *Artemia salina* Linnaeus, which lives in the salt ponds of Cabo Rojo and Guánica. Since sea water is evaporated to dryness in these ponds to obtain crude salt, their waters naturally have a much higher concentration of sodium chloride than does sea water, but this apparently provides an optimum environment for this almost transparent little fairy shrimp. In the limited area of these salt ponds, it

occurs in countless millions, forming a unique association with the maggots of the fly *Ephydra gracilis* Packard, and the other specialized organisms which can live in such an environment.

Of the marine Entomostracha of the coasts of Puerto Rico, nothing is given in the "Investigations of the Aquatic Resources and Fisheries of Puerto Rico by the United States Fish Commission Steamer Fish Hawk in 1899" published in two parts as Bulletin No. 20 of the U. S. Commission of Fish and Fisheries (1900) 1902. But of the crabs and lobsters, the shrimps, the hermit crabs and the marine Isopods it gives an extended account, greatly expanding the records of the collections by Dr. Juan Gundlach. To it, anyone interested in the marine life of the waters around Puerto Rico is referred.

The beach fleas, *Orchestia platensis* Kroger, which occur in such abundance under the windrows and masses of decaying seaweed on the beaches inside the reefs where it is not carried away by the waves, hop about with greatest rapidity when disturbed. The seaweed is a nuisance to bathers, but if they attempt to sit or rest on it, the beach fleas soon acquire courage to take little bites out of this temporary addition to their environment. Maggots of the grey Tabanid fly, *Tabanus nervosus* Curran, also live in the decaying seaweed, and feed on the beach fleas, sucking out the body contents and leaving only the empty shell of the flea.

In addition to the fifteen marine sowbugs discussed by Dr. H. F. Moore in his "Report on Porto Rican Isopoda" (Bull. U. S. Comm. Fish and Fisheries, 1900, **XX**, pp. 161–176, pl. vii–xi. Washington, D. C., 1902), almost as many more have been recorded by Dr. H. J. Hansen from the waters around St. Thomas. Apparently the most abundant are *Cirolana parva* Hansen, found everywhere in West Indian and Bahaman waters as well as around St. Croix, St. Thomas and Puerto Rico, and *Cilicaea caudata* (Say), which is red or pink in life, from coral reefs around Puerto Rico. Two species of *Dynamene* occur on mangrove roots on Culebra.

From "under algae and drift alongshore" on Culebra were collected two semi-terrestrial species: *Ligyda baudiniana* (Milne Edwards) and *Philoscia culebrae* Moore. Under beach drift is hardly the normal environment for the latter species, which has repeatedly been found since in cane fields of the north coast, having made irregular, shallow cavities in live cane roots near the tip. "If these sowbugs are abundant, the cavities may be enlarged and all the surface of the tender root injured," writes Mr. Francisco Seín in his discussion of "The Sugar-Cane Root Caterpillar, *Perforadix sacchari*, new genus and species, and Other New Root Pests in Puerto Rico" (Jour. Dept. Agr. P. R., **14** (3): 167–91, pl. 10, ref. 18. San Juan, August 1930). Or, they may continue feeding where some other animal has previously eaten, greatly enlarging the original lesion. The sowbugs do not penetrate to any great depth in the soil, but live for the most part

under the trash close to the surface, and of the soil animals present, are least responsible for initiating injury to cane roots.

None of the common continental or cosmopolitan sowbugs is found in Puerto Rico, but *Cubaris murina* Brandt has been collected at Pueblo Viejo under stones, and three species are described by Miss Harriet Richardson from El Yunque: *Sphaeroniscus portoricensis*, *Philoscia richmondi* and *Synuropus granulatus* in her "Key to the Isopods of the Atlantic coast of North America, with descriptions of new and little known species" (Proc. U. S. Nat. Museum, **23:** 493–579. Washington, D. C., 1901). The latter species, unlike typical common sowbugs, which curl up so easily into a ball like the armadillo that generic names are *Armadillo* and *Armadillidium*, has so broad a body as "not able to be contracted into a ball".

The large, blue-grey land crab, commonly known as "juey", *Cardisoma guanhumi* Latreille, is a serious pest in low-lying cane fields close to the ocean, for it feeds on the leaves of young cane as well as on those of other plants. Its holes in the swampy ground are also a nuisance, and common practise among cane growers is to poison the crabs when they become abundant. A bar of the element phosphorus is placed in water in a five gallon oil can and heated. When dissolved, corn meal is added slowly until a paste in formed, and thickened until it is of the right consistency for application. A small quantity of the paste on a paddle is placed at the entrance of each crab hole, and the elimination of the crab is anticipated with certainty. Many people enjoy eating jueyes, when assured that they have not been poisoned. People living near the beach often develop a minor industry, catching the crabs by digging them out of their holes, or hunting for them at night with a blazing torch. The crabs, held in captivity in pens, are fattened on sweet potatoes and plantains, or rice and beans from the table.

Two kinds of fresh water shrimps, locally called "guábara", occur in the streams of Puerto Rico. *Atya scabra* Leach is the common cosmopolitan species; *Xiphocaris elongata* Guérin is found only in the fresh water streams of the Antilles. The former has "pereiopoda with exopodites", the latter is without. They attain a surprising size, even in the smallest streams, and are an item of food for man of considerable importance. They occur in the swimming pool on El Yunque and elsewhere in mountain pools, and by their bold inquisitiveness as soon as one ceases to move are a most tiresome nuisance to bathers.

PERIPATUS

Peripatus, the only genus of the class Onychophora, is distinctly not a typical arthropod. Indeed, the first specimens collected in St. Vincent of the Lesser Antilles were thought to be molluscs (L. Guilding "*Mollusca*

caribbaeana: an Account of a New Genus of Mollusca" Zoölogical Journal, **2**: 443, pl. 14. London, 1826), and it was only much later that it was discovered that they breathe thru tracheae like insects. This first collection was representative of numerous species present in the West Indies. *Peripatus* generally prefers moist habitats, as under dead leaves and stones, or in rotten wood, but one species, *Peripatus juliformis danicus* Bouvier, has been found in comparatively dry St. Croix, under rotten logs, and in the rotten stump of a mamey tree. *Peripatus dominicae juanensis* Bouvier, is the only species of Puerto Rico and Vieques. In the ecologically isolated mountain peaks of Presque Isle of southern Haiti, three additional subspecies occur, as well as *Peripatus manni* Brues and *Macroperipatus insularis* Clark, while individuals of only one other sub-species of *dominicae* Pollard have been found in all the rest of Hispaniola, according to Prof. C. T. Brues (Psyche, **46** (1): 36–7, map. Cambridge, March 1939). Numerous species occur in Jamaica, but none has been collected in Cuba (A. H. Clark, Proc. U. S. Nat. Museum, **85** (1): 1–3, Washington, D. C., 1937).

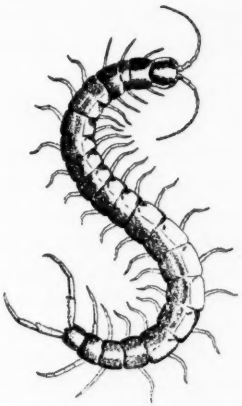
Peripatus shuns light, and two of the collections in Puerto Rico were in darkened bathrooms, in tubs in which the shower was dripping, at Río Piedras and Manatí, but others were in natural habitats, under forest litter, at Utuado and elsewhere along the north and west coasts. Three individuals were found in the mountains near Las Marías in piles of decayed yam leaves (October and November 1941).

The animals look somewhat like rather plump millipedes, usually dark in color, with a somewhat granular skin, but actually soft as a wet kid glove. They have long sensitive antennae and simple shining eyes, set like small diamonds on the side of the head. The females have 31 or more pairs of legs, the males of the same species usually a few pairs less. Adults of most species are often over two inches long, but some are little more than an inch in length.

When irritated, they eject from papillae beside the mouth a discharge of slime, which, altho apparently harmless and not adhering to the skin of the animal itself, is extremely sticky, and has been observed to be used in the capture of other small animals. The adults do not copulate. "The male deposits small, white, oval spermatophores, which consist of small bundles of spermatozoa cemented together by some glutinous substance, indiscriminately on any part of the body of the female," according to Adam Sedgwick ("Peripatus" *in* The Cambridge Natural History, pp. 1–26, fig. 14. MacMillan & Co., London, 1910). The young are produced alive and fully developed, gradually wandering off away from the mother.

SYMPHYLIDS

Much smaller and lighter in color than *Peripatus*, but possibly most closely related, are the Symphylids (Class Symphyla), which look like minute white centipedes. Even when adult, however, they have but twelve pairs of legs, and no eyes. The common international species (A. E. Michelbacher "The Biology of the Garden Centipede, *Scutigerella immaculata*, Hilgardia, **2** (3): 55–148, illus, many ref., Berkeley, January 1938) has not been collected in Puerto Rico, but another species, *Hanseniella* sp., has been found by Mr. Francisco Seín to be responsible for making "neat little round feeding cavities or pits, so common in cane roots in Puerto Rico that it is almost impossible to find a cane root without them." It has also been collected on similarly injured pineapple roots at Corozal, and presumably feeds on many kinds of plant roots in the more humid part of the Island. The injury is serious, but unless exceptional drought follows a period of high humidity favorable for the Symphilids, the plants continue to grow with what appears to us to be normal vigor.



The common centipede, *Scolopendra subspinipes* Leach, one-half natural size. (Drawn by Fritz Maximilien).

CENTIPEDES

Of the five less common species of centipedes (Class Chilopoda) recorded from Puerto Rico, Dr. Wm. M. Wheeler collected *Otocryptops melanostomus* (Newport) and *Otostigmus caraibicus* Kraeplin in the mountains above Utuado; two species, *Cupipes guildingi* (Newport) and *Geophilus culebrae* Silvestri, are found in Culebra, while *Scolopendra*

morsitans Linné, generally greenish in color, is a widely distributed species. The common species of coastal Puerto Rico, also present in all the other West Indies from Cuba to Trinidad, is *Scolopendra subspinipes* Leach. Despite its nocturnal habits, it is bright with red, orange and clear yellow coloration. The lighter-colored young are born with the full complement of 21 legs posessed by the adults, and have been found still associated with the mother in a nest under a rotted log for some time after birth. The eyes of centipedes consist of four ocelli on each side of the head, and they posess four pairs of jaws, one pair of which is modified into poison fangs. Their food consists of nocturnal animals, and sometimes one will see the elytra of May beetles discarded at the entrance of their hole in the ground. Their bite is painful and dangerous to man directly in proportion to the size of the centipede inflicting it, but is not fatal.

MILLIPEDES

Of the twenty or more species and subspecies of millipedes (Class Diplopoda) reported from Puerto Rico, the one of possibly greatest interest is a large reddish-brown arboreal species, the stomach of which Dr. R. T. Cotton ("Scale Feeding Habits of a Porto Rican Millipede, *Rhinocritus arboreus* (Saussure)" Jour. Dept. Agr. P. R., **1** (3): 175–6. San Juan, July 1917) found filled with the bodies of the purple scale of citrus, *Lepidosaphes beckii* Newman. In experimenting with these animals, he "placed about a dozen on several small grapefruit trees heavily infested with purple scale. At the end of two weeks the trees were perfectly clean and free of scales, and the bark took on a fresh green color." The normal food of most millipedes is decaying vegetable matter, and that one species should have adopted scale insects, at least in part, is of the greatest biologic interest, as well as of economic value. Two subspecies of *arboreus* occur in Puerto Rico: *gundlachi* Karsch, "which is lilac-colored, with a dorsal median red stripe", and *krugii* Karsch. The former has recently been noted on maga trees heavily infested with the pustule scale, *Asterolecanium pustulans* Cockerell, but at least in captivity they did not feed on the scales.

The formerly most common millipede, *Trigoniulus lumbricinus* (Gerstaecker), a somewhat smaller reddish-brown terrestrial species, feeds on decaying vegetation, and occurred in enormous numbers in malojillo meadows from which the hay was not cut as rapidly as it matured. Structures of concrete have a peculiar attraction to millipedes in rainy weather, and even constant sweeping of the concrete porches of houses out in the country did not serve to free them of its obstinate persistence. The introduction of the giant Surinam toad, *Bufo marinus* (L.), into Puerto Rico greatly reduced the abundance of this millipede, for the toad is not fussy as to its food, and the millipede moves just fast enough to

attract attention, but too slowly to escape. At the present time, one must really search to find many, the most likely place being a pile of cachaza that has been undisturbed for a few days.

Another millipede, mostly black in color, but with the edges of its dorsal plates prolonged laterally on each side to form conspicuous yellowish wings, is often found in dead seed cane pieces. Actually it is not responsible for the death of the seed piece, but the dead cane merely furnishes a favorable environment for the millipede. It has been identified as *Orthomorpha coarctata* (Saussure) by Mr. H. F. Loomis of Coconut Grove, Florida. It occurs in practically all of the West Indies, from Cuba to Trinidad. In Puerto Rico it forms an item in the food of the toad, and also of the introduced bullfrog, *Rana catesbiana* Shaw.

The Scale-Eating millipede, *Rhinocritus arboreus* (Saussure), one-half natural size. (Drawn by Fritz Maximilien).

The only extensive systematic discussion of these animals is by Dr. R. V. Chamberlin: "The Chilopoda and Diplopoda of the West Indies" (Bull. Mus. Comp. Zoology, **42** (5): 151–262. Cambridge, July 1918).

ARACHNIDA: Scorpionida

The common dull yellow, spotted scorpion most often seen in houses, sheds and garages in coastal Puerto Rico is *Isometrus maculatus* DeGeer, as identified by Prof. Nathan Banks. Sometimes much smaller and somewhat greenish young are found with their mother, to the number of half a dozen or less.

The plumper, reddish-brown scorpion found in the mountains is *Tityrus obtusus* Karsch.

On Mona Island, neither of these has been collected, but scorpions in general are much more abundant, being found under bark of trees and in dead logs. Prof. Banks identifies them as *Diplocentrus* sp. and *Centrurus* sp., possibly *nitidus* Thorell.

ARACHNIDA: Pedipalpida

On the walls of the caves at Aguas Buenas, Dr. Roman Kenk collected many enormous tailless scorpions, *Phrynus palmatus* (Herbst) (= *Tarantula reniformis* F., as identified by Prof. Banks). The body of even the largest of these "guabás" is not much more than an inch in length, but individual segments of their eight legs are longer than this, so that when its legs are spread out normally, the animal covers much space. In color it

is mostly reddish-brown, but the non-chitinized joints of its legs and palpi are strikingly white and conspicuous. Its palpi are strong and powerful, and are armed with numerous sharp spines, both long and short. Nothing is definitely known of its food habits, but Dr. Kenk thinks they are predaceous on cave crickets and other insects.

ARACHNIDA: Pseudoscorpionida

The false scorpions have no tail, but prominent chelate mandibles so large as to dwarf the remainder of the animal. The local forms are small to minute, usually reddish-brown in color, and are found under bark or in decaying vegetation.

ARACHNIDA: Araneida

The most extensive information concerning the nearly two hundred spiders (Arachnida: Araneida) recorded from Puerto Rico is most fortunately available because Dr. Alexander Petrunkevitch, a recognized authority on this class of animals, and Professor of Zoology at Yale University, was exchange professor at the University of Puerto Rico in 1925. His publication on "The Spiders of Porto Rico" (Transactions of the Connecticut Academy of Arts and Science, **30** (1): 1–158, fig. 150. January 1929; **30** (2): 159–355, fig. 240. January 1930 and **31** (3): 1–191, fig. 168, December 1930, New Haven) is quoted in the following accounts of a few of the more common and obvious spiders.

Miss Elizabeth B. Bryant has made "Additions to the Spider Fauna of Puerto Rico" (Jour. Agr. Univ. P. R. **26** (1): 1–19, pl. 2. Rio Piedras, May 1942), describing eleven new species from El Yunque and the Maricao Forest, collected by Dr. P. J. Darlington, and in "Notes on Spiders from Puerto Rico" (Psyche, **54** (3): 183–193, pl. 1. Cambridge, September 1947) describes four more, collected by Mr. Harry Beatty on El Yunque, and lists "three others that have never been reported from the island before". In "A List of Spiders from Mona Island, with Descriptions of New and Little Known Species" (Psyche, **54** (2): 86–99, pl. 1. Cambridge, June 1947), she describes four new species, including *Wixia serrallesi*, collected by Mr. Jorge J. Serrallés.

The common tarantula of Puerto Rico, *Cyrtopholis portoricae* Chamberlin, velvety black or dark brown except at the prominent whitish naked joints of the legs, is by no means so large and formidable as the hairy, spiny species of the larger islands and on the mainland. It is "found in large numbers thruout the Island up to an elevation of about 2,000 feet, but is most common in the low regions. It makes holes in the ground, varying in diameter and depth. One sees these holes in great numbers in gardens on bare soil, on lawns and meadows, in embankments along roads and in

the limestone hills along the northern coast. Large holes inhabited by adult individuals are one, to one and a half inch in diameter, without any web across. Neither is the burrow itself lined with silk. It is cylindrical, and about half way from the entrance becomes rapidly smaller, its diameter corresponding now to the diameter of the spider's abdomen. Most of the burrows are about one foot deep, usually not vertical, but inclined and often with a bend. At the mouth of the burrow one may commonly see remains of large millipeds constituting the chief food of these spiders. Both males and females make and live in burrows where they may be found at any time of year. But in midwinter, *i.e.* in December and January, one meets also males walking on the ground or climbing on the walls of buildings, presumably in search of females. Both sexes are very gamy, always ready to fight when in danger, the males even more so than the females." The only serious enemy of *Cyrtopholis portoricae* is *Pepsis marginata* PB, a large blue-black wasp with orange wings, the largest of its genus occurring in Puerto Rico, which attacks the spider and uses its limp body for food for its own larvae. Dr. Petrunkevitch's "Tarantula versus Tarantula-Hawk: a Study in Instinct" (Jour. Expt. Zool., **45** (2): 367–393, pl. 2. 1926) describes the fight between wasp and spider under cage conditions.

The infamous black widow spider, *Latrodectus mactans* (F.), the range of which is from the southern United States to Patagonia, including the West Indies, is "easily found in Puerto Rico, but by no means as common as in tropical Mexico". "The female is quite easy of identification, being the only spider of from 10 to 12 mm. in length (just under half an inch), with an almost globular abdomen of a shiny black, with a brilliantly red spot on its vetral surface, shaped like an hour-glass or a square; with black carapace and legs. The male is considerably smaller, and invariably shows the oblique red stripes of the youthful female."

"The species lives in webs which it spins either in crevices of rocks, or in hollows of trees, on some shrubs and cacti, in bamboo fences, in dark corners of buildings and on walls. The female has the habit of hanging in her web with her legs up and her back toward the ground. Occasionally she protects the entrance to the web by means of a tough membrane with a central circular opening. She makes from two to several egg-shaped, pointed, rather smooth, buff-colored cocoons which she suspends with threads in her web, and guards until the spiderlings emerge. Her food consists chiefly of large insects such as junebugs, grasshoppers, cockroaches, etc. For this reason and notwithstanding its poisonous qualities, the species must be regarded as being truly beneficial. The male is too small to bite through human skin and may be handled with impunity. The female, when disturbed, prefers to escape by running and rarely bites even

if taken in one's hand. She never attacks man of her own volition or on her own initiative. The only places where the spider may be really dangerous are the toilets, especially, of course, the old-fashioned outhouses. Here the female builds her web occasionally across the opening of the seat, encouraged to do so by the presence of numerous insects which in their turn are attracted by the odor of the excrement. In other countries cases are on record of men having been bitten on the genitals in the toilet, naturally with very grave consequences, for the effect of the poison is not local, but constitutional, comparable to that of the rattlesnake."

The bite of *Latrodectus geometricus* (C. Koch), greyish brown in color with black and white markings on the abdomen, "has also been found to be poisonous, altho its poison is less virulent".

One of the most striking of the smaller spiders of Puerto Rico is *Theridula opentula* (Walcknear), shining black in color, with bright yellow spots on the abdomen, and lateral and terminal humps that tend to become horns. A cosmopolitan species, "in Puerto Rico it is very common, found in small reticular webs on the leaves of various plants," and occurring from coastal cane fields to the top of El Yunque. It is of more particular importance to the cane grower because it appears to be a predator on the yellow aphid of sugar-cane, *Sipha flava* Forbes, even if it is too small and too scarce to be of much value in reducing really heavy infestations of the aphids.

The broad, white, enameled abdomen of *Gasteracantha cancriformis* (L.) has two prominent reddish horns on each side and two to the rear, suggestive of its specific name meaning "crab-shaped". It is a common neotropical species, but of widely varying abundance in Puerto Rico. Dr. Petrunkevitch collected no specimens here, but recent collections have been made at Guánica and near Mayagüez, and twenty years ago it was very abundant in the coconut grove near what is now the residence suburb of San Juan known as Punta Las Marías. Its egg-clusters, covered with a matting of light green silk, abounded in the cracks and crevices of old stems of bougainvillea vines, and of wooden houses. Few spiders emerged, however, as a Chloropid (Oscinid) fly, *Pseudogaurax lancifer* Coquillet, had parasitized most of them. It is quite possible that this parasite, endemic in Puerto Rico, may be responsible for the great variations here in the abundance of this quaint spider.

The abdomen of the more typical West Indian species, *Gasteracantha tetracantha* (L.), has only a single lateral horn on each side, but two behind. It is not found on the mainland, but occurs here in coastal coconut groves as well as high in the mountains.

With bodies and legs as elongate as the cane leaves on which one so often finds them, with the front legs close together in front and the abdomen and hind legs together stretched out in the rear, paralleling the mid-

rib of the cane leaf, rests the fragile, light brown *Tetragnatha pallescens* Cambridge, common in Puerto Rico from the coast to the top of El Yunque. During the daytime at least, one rarely sees these studies in elongation do anything but rest; they have no nest, not even scattered strands in which their presumed insect food might become entangled.

Metepeira labyrinthea (Hentz) "is a Pan-American spider distributed from Labrador to Patagonia. It is very common in Puerto Rico on fences, telegraph and telephone wires, plants, etc, and is found at all altitudes."

The huntsman spider, *Heteropoda venatoria* (L.) "is a cosmopolitan species found in all tropical and subtropical regions of the globe, and is quite common in the West Indies. The spider is very common in Puerto Rico, from the coast to the highest altitudes, wherever there are human habitations. It is one of the largest spiders of nocturnal habits, spending the day in cracks in wood, behind furniture, pictures and other objects, in cupboards, under stairways, and hunting during the night for insects, chiefly cockroaches. Nobody is afraid of the Huntsman Spider in the tropics." The peón calls it "araña boba", that any spider looking so ferocious should be so foolish as not to bite. "The cocoon is flat and the female carries it under her sternum. The male is somewhat smaller and has relatively longer legs." One sometimes finds an entire shed skin of this spider, with the legs expanded and perfect, but the abdomen shriveled, the hard carapace empty but unshrunken.

Selenops insularis Keyserling is the common large mottled brown and very much flattened spider "pre-eminently adapted to life under loose bark or between bases of the leaves of such plants as Bromelia, pineapple, Pandanus, various palms, etc. Here they hide, living on insects, and if disturbed, run with amazing swiftness to the nearest crack or crevice. The females make flat cocoons containing the eggs, which they guard."

Of the jumping Attid spiders, which construct no nest, the one most common is the cosmopolitan *Plexippus paykulli* (Audouin), which is "the largest jumping spider found in Puerto Rico, and is distributed throughout the Island." At higher elevations, especially in coffee groves, the common species is *Corythalia* (*Prostheclina*) *signata* (Banks), conspicuous with its irridescent blue-green markings and constantly vibrating palpi. During wet weather, it is attacked and killed by a fungus, *Gibellula arachnophila* Sacc., and its dead body will be seen stuck to a coffee leaf by the hyphal strands of the fungus.

Besides this fungus, the tarantula-hawks and the Chloropid fly parasitic on the egg-clusters of *Gasteracantha*, another enemy of many spiders is the large yellow and black wasp, *Tromatobia cressoni* (Dewitz), which has repeatedly been reared from egg-clusters of various large spiders. The

tarantula-hawk attacks and paralyzes a single tarantula at a time, and when burying the parasitized tarantula in hard-packed ground, lays a single egg upon the abdomen of the spider. The mud-wasp, *Sceliphron caementarium* Drury, first builds her mud nest, all but the final seal, and then catches and stings, one by one, numerous small spiders which she brings to fill the nest, lays her egg and seals them all in with a final daub of mud. In both cases, the sting of the wasp merely paralyzes the spider, which remains alive but inactive: a supply of fresh food for the larva of the wasp sufficient in amount for its complete development to adult. The adult tarantula-hawk weighs only an eighth as much as does the tarantula, comparable to the ratio between the weight of the little spiders assembled in a single cell of its nest by *Sceliphron*, and its own weight. Against the wasps specifically attacking them, spiders neither make, nor attempt any defense except that of hiding or running away. And against the insects parasitizing egg-masses, there is no protection. Thus are revenged the insects caught by jumping spiders, or in the sticky silken webs of others from which every attempt to escape only entangles them the more securely.

TICKS

Ticks (Ixodoidea) and mites (Acarina), which are the most abundant members of the order Acarida, class Arachnida, differ most obviously from spiders in having an unsegmented body with the abdomen broadly joined to the cephalothorax, but like the spiders, most of them have eight legs when adult. To be sure, seed-ticks have but six legs, and might easily be mistaken for insects, but they moult to eight-legged nymphs, which in turn become eight-legged adults. The larval ticks (seed-ticks), the nymphs and the adults are all parasitic on higher animals, but not necessarily warm-blooded animals. *Amblyomma cruciferum* Neumann has been found on the large iguana lizard, *Cyclura stejnegeri* B. & N., on Mona Island (H. Douglas Tate, "Biology of the tropical cattle tick and other species of ticks in Puerto Rico, with notes on the effects on ticks of arsenical dips" Jour. Agr. Univ. P. R., **25** (1): 1–24, ref. 3. Río Piedras, July 15, 1941). The first giant Surinam toads, *Bufo marinus* (L.), brought to Puerto Rico from Jamaica, were found infested with the tick *Amblyomma dissimile* Koch. The ticks were removed from between the eyes (the only place on the toad's body which it is unable to reach and scrape them off), so that *Bufo* in Puerto Rico is relieved of the incubus of one enemy attacking it on the mainland, as well as in some islands where it was introduced.

The common cattle tick, *Boöphilus* (*Margaropus*) *annulatus microplus* (Can.), is injurious not only because of the direct loss of blood, but also because a serious disease of cattle, Texas fever, is transmitted by these

ticks. The transmission is not direct, as is malaria by mosquitoes, but fully-engorged female ticks falling from cattle which have had the fever when young and have thus become immune, lay eggs from which hatch seed-ticks that transmit the disease to the first animal from which they suck blood. Cattlemen in the northern United States noted that when Texas longhorns were driven to market along roads beside their farms, this was almost invariably followed by an outbreak of what came to be called "Texas fever" in their animals. The tick can not withstand the cold of northern winters, thus northern cattle do not acquire immunity to the fever by being infested with infected ticks while young. Following the proof of the role of the tick in causing Texas fever, campaigns to eliminate the tick in the southern United States were initiated, so that at the present time only in the wildest regions, where the presence of deer and other wild animals complicates the problem, does the tick still exist.

In Puerto Rico, all so-called "native cattle", descended from those imported from Spain or elsewhere, have acquired immunity, but dairy cattle of improved breeds, imported from parts of the United States where there are no ticks, suffer heavy mortality when brought here as adults. Thus a similar campaign to eliminate the cattle tick in Puerto Rico was initiated some time ago, and at the present time the continued existence of the cattle tick is possible only where the clean-up has not been entirely effective. Because the principal importation of cattle for slaughter in Puerto Rico is from the Virgin Islands, a similar clean-up campaign was also started there, the results of which tend to be ineffective because of the presence of wild deer in the cactus scrub of northern St. Croix.

Cattle ticks may also develop on susceptible individual sheep, goats, horses and very rarely on dogs, but not on any other wild or domestic animals present in Puerto Rico. Naturally, all of these animals likely to harbor cattle ticks must be dipped in the arsenical vat at the same time and as many times as are the cattle if the eradication is to be perfect.

The ears of horses often, and more rarely other parts of their bodies, and of mules in Puerto Rico, are infested with the so-called tropical horse tick, *Dermacentor nitens* Neumann. In many ways this is similar to the cattle tick, and is killed by immersion in the arsenical dip, if this reaches all parts of the skin of the infested horse or mule.

The so-called brown dog tick, *Rhipicephalus sanguineus* Latreille, occurs on dogs of all colors in Puerto Rico, but is somewhat harder to see on those that are brown in color. Stray dogs often escape constant re-infestation by this tick, as house dogs do not, because the fully-engorged females tend to drop off at night where the dog sleeps, and not to wander far before laying eggs. The minute seed-ticks are inconspicuous until they become engorged, when on the white patches of a dog they produce a speckled

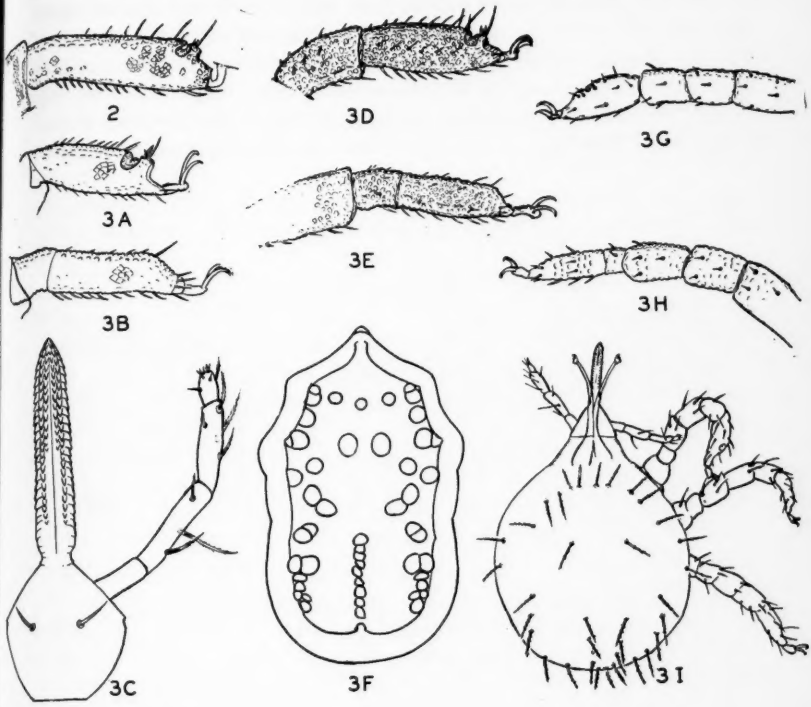
appearance. Of course it is possible to destroy these ticks by dipping a dog in a cattle dipping vat, and these are often readily available in Puerto Rico, but sometimes that is not practical. As an alternative, hand-picking must be adopted: on the dog before the ticks become of full size, and after the adults fall off in the area inhabited by the dog, and especially where it sleeps. A liberal application of derris powder will kill most of the small ticks, and bathing in diluted cresol, or with "dog soap" is also of value.

What looks like little black flies that one sometimes sees crawling between the hairs of tick-infested dogs are really parasitic wasps, which attack the nymphal dog ticks. Named by Dr. L. O. Howard after its discoverers, Drs. W. D. Hunter and W. A. Hooker, *Hunterellus hookeri* is sometimes so abundant as to be a very effective parasite. Ordinarily, seven to ten wasps develop to maturity in a single fully-grown nymphal tick. Temporarily, it may destroy most of the dog ticks in limited regions, but experiments in introducing it into regions where it does not normally occur have been disappointingly fruitless.

"*Ornithodorus puertoricensis*, a New Tick from Rats in Puerto Rico" (Journal of Parasitology, **33** (3): 253–9, fig. 3, ref. 22. Baltimore, June 1947) was described by Dr. Irving Fox, who found approximately a quarter of the rats in the metropolitan area infested with larvae of this tick on the back or sides. "Feeding of the nymphs and adults on rats is accomplished in 20 to 40 minutes; the nymphal stages are capable of existing for long periods without feeding at all, as a number have been kept in vials for more than 8 months. It may be assumed that the nymphs and adults remain hidden in the nests and other places frequented by rats. They are not known to attack man in Puerto Rico". Dr. Irving Fox records "The Occurrence of a Rare Genus of Ticks on Bats in Puerto Rico (Acarina: Spelaeorhynchidae)" (Jour. Agr. Univ. P. R., **26** (4): 95–7, ref. 10. Río Piedras, March 29, 1943), tentatively identified by Dr. H. E. Ewing as *Spelaeorhynchus latus* Banks, and Prof. Banks is himself responsible for the questionable record of *Antricola marginatus* (Banks) from a West Indian bat, probably from Puerto Rico.

Chickens from the dryer portions of Hispaniola, and the crates in which they are brought to Puerto Rico, are often infested with the fowl tick, *Argas miniatus* Koch (= *Argas persicus* (Oken)). This tick has been known from Port-au-Prince since 1927 (see "Entomologie d'Haiti", page 409) and possibly has been present in Hispaniola for a long time previously. Moreover, it is probable that it had already become established at Guánica and Ponce from importations from Santo Domingo before careful inspections had begun on the crates and their contents. The habits of the fowl

tick resemble those of bedbugs, the flattened leathery females being able to live for a long time in cracks of an uninhabited chicken-coop. When a host is present, they come out of hiding as soon as darkness hides them from the unsuspecting chicken, and by morning are fully-engorged with its



Ticks from Rats:

2. Tarsus I of adult of *Ornithodorus talaje* (Guérin-Méneville) from Mexico.

3. *Ornithodorus puertoricensis* Fox from Puerto Rico:

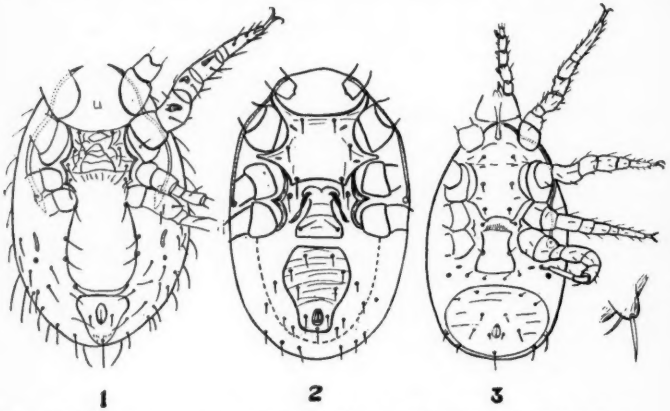
3A. Tarsus I of female, 3B, Tarsus IV of female, 3C, Capitulum of larva, 3D, Tarsus I of fourth nymph, 3E, Tarsus IV of fourth nymph, 3F, female shape and pattern of disc, 3G, Tarsus I of first nymph, 3H, Tarsus IV of first nymph, 3I, larva, dorsal view. (Drawn by Irving Fox).

blood. They do not remain on the host as adults, and before daylight are safely hidden in a crack, where they remain until after they have laid their eggs. This may be repeated several times. Both larval and nymphal ticks hide in cracks while moulting, but it takes them longer than over-

night in which to become fully-engorged, thus they may be found on infested hosts even in the daytime.

MITES

Mites are generally much smaller than ticks, and mostly feed on vegetation, but one often sees some kinds of mites apparently attached to, or at least clinging to insects, like heavy infestations of ticks on higher animals. The larger beetles, such as the rhinoceros beetles, and notably the large green Cerambycid, *Chlorida festiva* L., often have large numbers of mites clinging to their legs or thorax. These are the hypopi, or migratory



Three New Mites from Rats in Puerto Rico described by Dr. Irving Fox:
1. *Androlaelaps setosus*, ventral plates and leg II.
2. *Macrocheles alatus*, ventral plates.
3. *Asca duosetosa*, ventral view and dorsal tubercle. (Drawn by Irving Fox)

nymphs of various species of *Tyroglyphus* (the only one determined to species being *Tyroglyphus heteromorphus* Felt on *Strataegus* grubs), or *Trichotarsus*, *Gamasus* or *Hologamasus*, merely catching a ride on their insect host, and not sucking blood from the insect. Even termite nymphs have been observed with mites clinging to them, but eventually the mites discovered the termites didn't go anywhere, or only in circles, and moved off under their own leg power. The adults of these mites attack grain, cheese and mushrooms, and are sometimes serious pests. In his studies on white grubs, however, Mr. E. G. Smyth noted that when a female rhinoceros bettle laid her eggs, some of the mites dropped off her body and began feeding on the eggs, a single minute mite emptying the egg-shell of its contents and attaining enormous size. These mites were never identified,

altho presumably they were some of the above that have modified their habits under tropical conditions.

"The American mushroom mite (*Tyrophagus* (formerly *Tyroglyphes*) *lintneri* (Obs.)) is sometimes troublesome" in the conditioning or storing of vanilla beans, according to Dr. Norman F. Childers and Mr. Héctor R. Cibes, in their account of "Vanilla Culture in Puerto Rico" (Circular No. 28, Federal Experiment Station, Mayagüez, pp. 94, fig. 58, ref. 27 and many additional ref., Washington, D. C., June 1948), imparting a bad odor to the beans. "In cases of limited infestation, they can be treated with alcohol or sunning. Mites can be controlled by fumigating the curing and conditioning equipment and the entire room with sulfur."

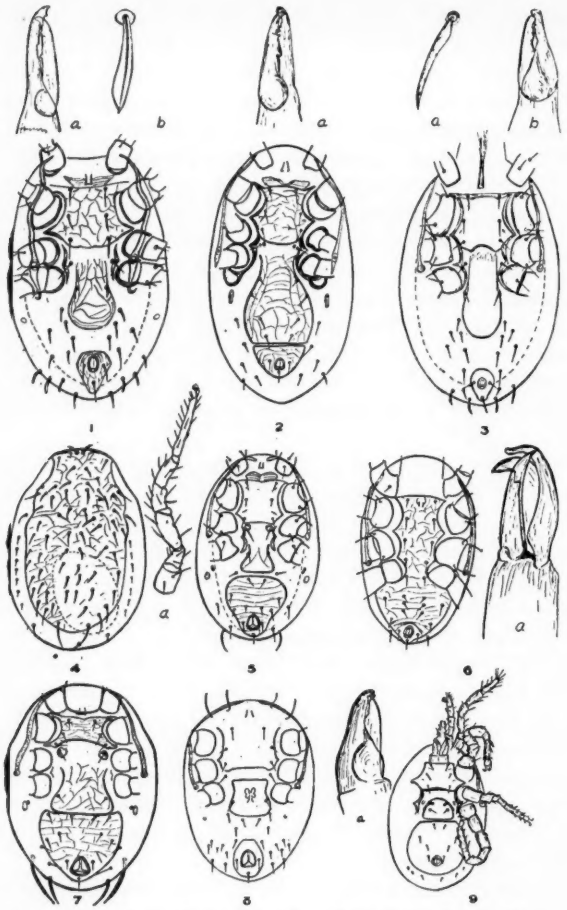
Mites are an important item of food for the "zapitos" or minute toads of *Bufo marinus* when just transformed from the tadpole stage: *Asca duosetosa* Fox, and species of *Scheloribates* and *Tyhypochthonius* having been identified by Dr. E. W. Baker from material collected by Mr. Mario Pérez.

In "A Review of the Mites of the Family Cheyletidae in the United States National Museum" (Proc. U. S. National Museum, **99** (3238): 267–320, pl. 17. Washington, D. C., 1949), Dr. Edward W. Baker describes *Cheyletus malaccensis* from St. Croix, *Cheyletia wellsi* from sugar-cane at Mayagüez and *Eutogenes foxi* from rat at Gurabo.

Dr. Irving Fox has described "Three New Mites from Rats in Puerto Rico" (Proc. Biol. Soc. Washington, **59**: 173–5. Washington, D. C., December 23, 1946); "Seven New Mites from Rats in Puerto Rico" (Annals Ent. Soc. America, **40** (4): 598–603, pl. 1. Columbus, December 1947) and "A New Genus *Borinquolaelaps*, and New Species of Mites from Rats in Puerto Rico" (Journal of Parasitology, **32** (5): 445–452, pl. 1, ref. 11. Baltimore, October 1946) besides recording the occurrence of such cosmopolitan species as *Bdellonyssus bacoti* (Hirst) *Myobia musculi* (Schrank), *Radfordia ensifera* (Poppe), *Echinolaelaps echidninus* (Berlese) and *Laelaps nuttalli* Hirst.

The shining brown mites found under leaf-sheaths of sugar-cane feeding on debris and excrement of the caterpillars of *Diatraea saccharalis* F., have been identified as *Damaeus nitens;* those in rotten cane stalks as *Liacarus;* those under bark of decaying trees as *Uropoda;* and on gramma grass and on bark of living trees, very quaint dull brown mites with concentrically ringed abdomens are *Neoliodes concentricus.* The indefinite character of the information about these mites indicates how little they have been studied, either here or elsewhere.

In the imported hay brought to Camp Las Casas at Martín Peña during World War I was white clover seed that started growing in the roads after the camp had been abandoned, and in cane fields nearby the underside of



New Species of Mites from Puerto Rico described by Dr. Irving Fox:

1. *Cosmolaelaps gurabensis* female, ventral view of body; *a*, chelicera; *b*, dorsal seta.
2. *Mysolaelaps stigmatus* female, ventral view of body; *a*, chelicera.
3. *Ischnolaelaps alexandrini* female, ventral view of body; *a*, dorsal seta; *b*, chelicera.
4. *Borinquolaelaps dentatus* female, dorsal view of body; *a*, Leg I.
5. *Borinquolaelaps dentatus* female, ventral view of body.
6. *Ischnolaelaps alexandrini* male, ventral view of body; *a*, chelicera.
7. *Borinquolaelaps coronatus* female, ventral view of body.
8. *Borinquolaelaps mariposus* female, ventral view of body.
9. *Macrocheles fonsecai* female, ventral view of body and legs of one side; *a*, chelicera. **(Drawn by Irving Fox)**

the leaves of young plant cane was found infested with little green mites that caused injury looking much like that produced by the yellow aphid. This was the first record of *Paratetranychus viridis* Banks in Puerto Rico; a few months later to be found at Patillas, Trujillo Alto and Barceloneta. Subsequently, this mite, which attacks many economic crops in the southern United States, disappeared quite as completely as did the struggling plants of white clover, and neither has been found here since. Quite recently, however, another green mite attacking the underside of the leaves of sugar-cane, but causing no reddening, merely a blotching simulating mosaic disease, has become quite abundant on the north coast, notably on the new variety Mayagüez 28. It proved to be new, and was described by Mr. E. A. McGregor as *Paratetranychus sacchari* ("A New Spinning Mite attacking Sugar Cane in Puerto Rico" Jour. Agr. Univ. P. R., **26** (4): 91–94, pl. 1. Rio Piedras, March 29, 1943).

Other local species are *Tetranychus quinquenychus* found on leaves of garden pea, *Tetranychus telarius* (L.), on alfalfa, and the red spider of cotton, *Tetranychus bimaculatus* Harvey, sometimes found on the underside of cotton leaves during exceptionally dry weather, but rarely in Puerto Rico a serious pest.

Very different in appearance and habits from these red or green "red spiders" are the Tarsonemid mites (H. E. Ewing "A Revision of the Subfamily Tarsoneminae of North America, the West Indies and the Hawaiian Islands" Technical Bull. No. 653, U. S. Dept. Agr., pp 64, fig. 25, ref. 35. Washington, D. C., January 1939), which have the two pairs of front legs far distant from the two rear pairs. Practically every stalk of sugar-cane harvested in Puerto Rico shows the former presence of *Tarsonemus bancrofti* Michael (= *spinipes* Hirst) as a rusetting or roughening of the rind, the pattern of which is often characteristic of the variety of cane, and indeed has often been included in its description. This mite, first described from Barbados, now occurs nearly everywhere that sugar-cane is grown, having usually been spread on introduced varieties. Live mites are to be found only on the young shoot under the leaf-sheaths, minute and whitish, each in a separate crater or depression in the tender rind. As the cane ages, the live mites disappear, but the multitude of coalescing craters, becoming darker, eventually forms the russeting present on every joint of the cane. The injury to the cane is negligible, and growers never realize the presence of this mite unless they have been in some isolated region, like the Tambo Valley, Perú, where the mite has been accidentally introduced recently, and the difference in appearance of the cane is then apparent.

Under the base of the closely appressed leaves of the pineapple one also sees a somewhat similar injury caused by *Tarsonemus ananas* Tryon, first described from Queensland, later noted in Hawaii, and since found every-

where that Smooth Cayenne pineapples are grown. The actual injury is negligible.

Much more serious is the injury caused by *Hemitarsonemus latus*, described by Prof. Nathan Banks from mangoes grown in a greenhouse at Washington. Mangoes may have been the original host, but if so, the mite has greatly widened its host range, and in St. Croix and more recently in Puerto Rico it has become a very serious pest of peppers. "When they are attacked by it, the leaves of pepper assume a dwarfed, deformed, wrinkled, warty and scabby appearance, and the young terminal shoots show an excessive multiple bud formation", to quote from Mr. Charles E. Wilson, Entomologist of the Virgin Islands some twenty years ago. Lighter infestations cause a mottling of the pepper leaves simulating mosaic disease, and even such comparatively light infestations greatly reduce the crop produced. These mites are more abundant during dry weather, but they have now come to be an almost omnipresent pest in Puerto Rico. Control is by spraying with lime-sulfur, which must be constantly repeated thruout the cropping season if the pest is to be merely kept under control, for its elimination now seems impossible.

Crumpled or deformed leaves, or irregular warty excressences on the leaves or other parts of the cotton plant are caused by a blister mite, *Eriophyes gossypii* Banks. The gall produced by this mite is much larger than the animal itself, for the fully-grown mites are microscopic in size, being less than a hundredth of an inch in length. Even with a powerful lens one can with difficulty distinguish them among the numerous hypertrophied plant hairs which line the cavities inside the warts which their presence has caused, and within which they live. Gall-making mites have but four legs, a pair each side, and are not even spider-like in appearance, or tick-like in shape, being elongate and cylindrical. Sometimes the galls caused by these mites occur on young cotton plants, but ordinarily only the older plants are infested to any extent. Indeed, the infestations spread but slowly, and by picking off infested leaves, or by destroying the entire plant, any further extension can be prevented in the field. The wild Marie Galante cotton appears to be immune to infestation, but the Barbadense wild cotton is very susceptible, and the mite is carried over the dead season for Sea Island cotton on this wild host. Naturally, such old trees of wild cotton should be destroyed, quite as much to eliminate pink bollworm as to control blister mite. Indeed, the occurrence of blister mite in a field of Sea Island is the clearest indication of the imperfect character of the wild cotton clean-up: a premonition of the damage due to pink bollworm sure to appear later.

The "verruga" or warts caused by the cotton blister mite are more extreme, but not different in character from those caused by other species of these mites on their respective hosts: *Eriophyes guazumae* Cook on guacima leaves, *Eriophyes miconiae* Cook on the leaves of the local species of *Miconia* known as "camasey", *Eriophyes cordiae* Cook on the leaves of some species of *Cordia*, and *Eriophyes calophylli* Cook causing the hairy brown areas on the underside of the distorted leaves of "María" (*Calophyllum antillanum*).

The scab or itch mites are parasitic on higher animals. They are minute, whitish, hemispherical in shape, with the front pairs of legs widely distant from the rear pairs. The females burrow into the skin, and the young hatching from their eggs make other burrows, causing a diseased condition called scabies or mange. The dog mange mite, *Sarcoptes scabei canis* Gerlach, may attack man as well as dogs. Bathing in much diluted carbolic acid (cresol) is usually effective in control. Dr. W. F. Wooldridge has shown that an ointment containing "The Gamma Isomer of Hexachlorcyclohexane in the Treatment of Scabies" (Jour. Investigative Dermatology, **10** (5): May 1948) is very effective. A similar mite attacking rabbits, *Psoroptes cuniculi* (Delafond), especially on the ears, is sometimes so seriously abundant as to cause the death of the host, and is always a constant liability. Dr. H. L. Van Volkenberg in "An Annotated Check List of the Parasites of Animals in Puerto Rico" (Circular No. 22, P. R. Expt. Station, pp. 12, ref. 49. Washington, D. C., January 1939) lists a dozen or more others: *Otodectes cynotis* Hering: the ear mite of the dog and cat—unimportant; *Notoedres cati* (Hering): the head mange mite of the cat—common; *Psoroptes bovis* (Gerlach): the scab mite of cattle—infrequent; *Psoroptes equi* (Hering): the psoroptes mange of the horse—common, especially in the southern coastal plain and mountain regions; *Sarcoptes equi* Gerlach: the equine sarcoptic mange mite—rare in the horse; *Sarcoptes suis* Gerlach: the sarcoptic mange mite of swine—the mite is common, but the mange is unimportant; *Desmodex canis* Leydig; the dog follicle mite—apparently rare in dog; *Desmodex phylloides* Csokar: the swine follicle mite, frequently encountered in slaughtered hogs, but the mange is unimportant; *Desmodex bovis* Stiles: apparently rare in cattle; *Liponyssus bursa* (Berlese): the tropical fowl mite, common; *Cytoleichus nudus* (Vizioli): the air sac mite; *Trombicula tropica* Ewing: the tropical harvest mite, of which the larvae are frequently found on the horse, less often on goat and chicken; *Megninia cubitalis* Megnin and a species of *Epidermoptes:* feather mites, apparently common on the chicken; all of these mites having been determined by Dr. H. E. Ewing.

INSECTA

THYSANURA: Silverfish

The very simplest and most primitive of insects are neither microscopic in size nor so rare that only the specialist ever sees them. The big, fat, inch-long (if one includes antennae and the three long appendages at the hind end of the body) silverfish (Thysanura) that one almost invariably finds on disturbing old books and papers, especially old fiber-board shipping cases, are representative of the oldest insects in the world. The cosmopolitan **Lepisma saccharina** L. is the large, silvery-grey species common in Puerto Rico. Dr. J. W. Folsom, a specialist in this order of insects, described as new the local blue-grey **Ctenolepisma reducta,** the type of which was collected in the envelopes holding the scale insect collection of the Experiment Station at Río Piedras ("A New Lepismid from Puerto Rico" Proc. Ent. Soc. Washington, **25** (7–8): 169–170, fig. 8. Washington, D. C., October–November 1923). It also occurs in decrepid polilla-eaten furniture, but not in the tunnels occupied by living termites.

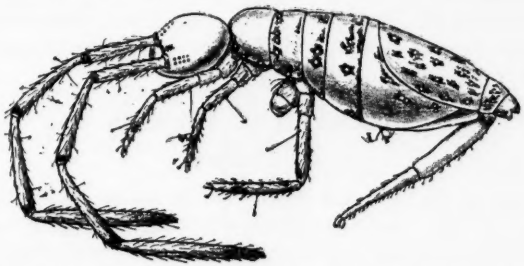
The female silverfish lays white, spherical eggs, from which the hatching young appear as minute replicas of their parents. Nobody has reared them to adult in the tropics, but it is presumed that growth is almost as slow as of cockroaches, which require a full year to become mature. Silverfish are primarily nocturnal, inhabiting storerooms and filing cabinets, bookcases and garages, feeding upon the paste, glue, sizing and glazing of paper and paper products. The aluminum sulfate used in glazing heavily coated paper, which to a certain extent is repellent to dry-wood termites, seems to be especially attractive to silverfish, as is also the adhesive used in the manufacture of corrugated paper or fiber boxes. Practically all methods of control generally recommended are as messy as the insects themselves: sprinkling powdered pyrethrum, borax or sodium fluoride, or a poison bait consisting of flour and white arsenic (one pint flour, to one-half ounce arsenic) making a thin paste with water and painted on cards to be distributed where the silverfish abound. The superior attractiveness of corrugated cardboard is so marked that by folding up a square of it in a drawer or letter-file, and daily killing the one or more silverfish to be found ensconced in its folds, one will soon reduce the local silverfish population to the vanishing point.

Before men had letter-files and bookcases in Puerto Rico, before the present flood of corrugated paper boxes began to arrive on the Island, silverfish lived outdoors in such dry and dark places as in dead cacti, under bark of trees and under dry leaves on the soil. Some wild silverfish, preferring a more moist environment, never entered the buildings of man, and are now found living in soil and feeding on the roots of sugar-cane, caña brava, bamboo and other plants. Dr. Folsom identified two species which had been collected in such environments by Mr. Francisco Seín as **Lepisma** sp.

and **Nicoletia** sp., presumably new and endemic. They cause considerable injury to sugar-cane, injury which becomes noticeable under unfavorable conditions such as during periods of extended drought. No method of control can be suggested, indeed there is little the cane grower can do except by general improvement of the conditions of soil and environment under which the cane is being grown.

COLLEMBOLA: Springtails

Springtails (Collembola) are minute to microscopic in size, and owe their name to the relatively enormous spring attached to the underside of next to the last abdominal segment, which they use as grasshoppers do their hind legs, for jumping. Altho presumed to be present, so little was known specifically of any springtail in Puerto Rico that at the time of the rapid spread of mosaic disease of sugar-cane, Mr. F. S. Earle wrote of the undescribed species which he thought might possibly be implicated in the transmission of mosaic disease, as follows. "This minute insect is present,



The Sugar-Cane Springtail, *Salina wolcotti* Folsom. About fifty times natural size. (After Folsom.)

literally by the million, in every cane field in Porto Rico, living, all stages together, on the lower side of the older leaves, or in very dry weather retreating into the enrolled bud spindle. Its minute scarifications are the immediate cause of most of the "ringspot" which is so common there on the older leaves." Eventually it was described by Dr. J. W. Folsom as **Salina wolcotti** ("Insects of the Sub-Class Apterygota from Central America and the West Indies" Proc. U. S. Nat. Museum, **72** (2702): Art. 6, 1–16, pl. 8, ref. 12. Washington, D. C., 1927). It is very abundant, especially during dry weather, and not only on sugar-cane and corn, but on such unlikely hosts as yautía, canna, water hyacinth and presumably many other plants. The adults are large for springtails, and readily visible without the aid of a hand-lens. They are light yellowish-green in color, with the segments of the antennae marked with brown at the joints, especially the first one. Altho occurring in such large numbers, individually they are so small that the actual damage they do to the host is negligible, and up to now they have not been implicated in the transmission of any disease.

The yellow-green *Salina* is not the only springtail to be associated with sugar-cane: under older leaf-sheaths one often finds another purplish-pink one, **Lepidocyrtus nigrosetosus** Folsom, which stands out in sharply contrasting colors against its background. It also occurs during damp weather in the cane trash on the ground, and under wet leaves of trees on the ground. This, or another species of the same genus, occurs under stones on Mona Island, as reported by Prof. J. A. Ramos in "The Insects of Mona Island." The cosmopolitan **Xenylla welchi** Folsom, as determined by Dr. Folsom, a blue-green springtail found also in Costa Rica, has been noted once in enormous numbers crowded close together on the moist earth of a ditch at Río Piedras. **Entomobrya cubensis** Folsom has been collected on decaying fruit of papaya, on cucumbers and on bamboo twigs. **Cyphodeirus inaequalis** Folsom, originally described from bat dung in limestone caves in the Canal Zone, has been collected in Puerto Rico in moss around the roots of orchids. These and the only other records of springtails: **Achorutes** sp. and **Campylothorax** sp., indicate how little this order of insects has been studied in Puerto Rico, for many other species are presumably present in favored environments such as on fungi, and in the forest mould of coffee groves and tropical rain forests.

DERMAPTERA: EARWIGS

Labiduridae

The forceps at the hind end of the body of the earwig, or "pica y huye, o piquijuye" as this insect is called locally, distinguishes it from all other Puerto Rican insects, and also from the dark brown or blackish Staphylinid beetles which seem so similar to earwigs because of their short forewings, the elongate shape of the body and the type of environment where both are most often found. In the open, earwigs often run about with the hind end of their body curved back and up, displaying their forceps to the greatest advantage, if it is for warning or protection. Originally, the earwigs were considered as being only a family, Forficulidae, of the Orthoptera, but are now placed in a separate and distinct order, the Dermaptera.

The late Mr. A. N. Caudell, of the U. S. National Museum, specialist in the Orthoptera and allied orders, described from Puerto Rico as *Borellia minuta* (Jour. N. Y. Ent. Soc., **15** (3): 168. New York, 1907) what is now considered a synonym of **Euborellia stali** (Dohrn). In listing the "Dermaptera (Earwigs) of the U. S. National Museum ("Proc. U. S. Nat. Museum, **38** (1760): 443–467. Washington, D. C., August 20, 1910). Dr. Malcom Burr records from Puerto Rico *Anisolabis maritima* (Géné), *Euborellia annulipes* (Lucas) as an *Anisolabis*, and, as *Borellia janierensis* Dohrn, *Anisolabis ambigua* Borelli, and under all of these names, specimens from Puerto Rico have since been identified. Mr. Morgan Hebard (Trans. Amer. Ent. Soc., **47** (4): 322. Philadelphia, 1922) considers that all of

these records refer to but a single species, his **Euborellia caraibea.** This is a large, unmarked, shining, brown earwig with a somewhat plump abdomen, which has repeatedly been collected in the ground associated with decaying cane seed, under dead leaves, in rotten pods of *Inga laurina* and with rotten or decaying vegetables. Despite its retiring habits, it has been found in the stomachs of the crested lizards, *Anolis cristatellus* and *Anolis krugii*, and is reasonably common in all parts of the Island, from Guánica to Mayaguez, Manatí, Río Piedras and Fajardo.

Adult of *Carcinophora americana* (Palisot de Beauvois), twice natural size. (Drawn by Fritz Maximilien).

Another large earwig with light-colored head, but black eyes, which has two teeth on each jaw or tine of its forceps, is **Labidura riparia** (Pallas). Dr. Gundlach notes of this species "se encuentra debajo de las cortezas sueltas de los árboles muertos", where also he found *L. dufouri* Desm., and *L. pallipes* Duf. both now considered synonymous. As *L. bidens* Olivier it was subsequently identified, carrying a honey-bee on the plaza at Mayagüez. Dr. Luis F. Martorell found these earwigs, as identified by Dr. A. B. Gurney, abundant on Mona Island at the lighthouse at night, where they were running about collecting dead or injured insects that had been attracted to the light.

Another large earwig, **Carcinophora americana** (Palisot de Beauvois), of which Herr G. Burmeister (Handbuch der Entomologie, **2: 753.** Berlin,

1838) described the local variety in Puerto Rico as **gagathina,** has dark-colored rearwings, but the tegmina are lighter-colored along the median suture. Listed by Dr. Gundlach, and by Malcolm Burr as a *Psalis*, this was number two in Van Zwaluwenburg's list. It lives under the bark of dead trees in the mountains, having been collected at Jájome Alto (Cayey), Maricao, Naguabo and on El Duque in the Luquillo Mts. It has repeatedly been found in the trash around banana plants, and in the tunnels of the corm borer, *Cosmopolites sordidus* Germar. In the laboratory, it has been fed upon the larvae of the corm borer, and it may be a considerable factor in the control of this pest, but admitedly it is very difficult to prove that it will attack healthy undisturbed *Cosmopolites* larvae in the field.

Forficulidae

One of the largest and possibly the most common earwig at present in Pureto Rico is **Doru albipes** (Fabricius). It not only has light-colored legs, but also a light-colored spot at the base of each tegmen (or elytron), and light-colored hindwings, which protrude for nearly half their length from beneath the covering tegmina, giving a very distinctive 4-spotted appearance. As a *Phaulex* it is number one in Van Zwaluwenburg's list, but was not noted by Dr. Gundlach. Like other earwigs, it is normally nocturnal in its habits, and by day is to be found hiding under the bracts of cotton squares or bolls, under cane leaf-sheaths, or under bark of dead trees. It is often to be found in the hollow twigs of "bucare" and "jagüey" that have been left empty by caterpillar borers, and possibly from which the earwigs themselves may have eaten the boring caterpillar which made the tunnel. It also lives in the miniature Neisen huts which were the cocoons of the local pussmoth or "plumilla", or of the seagrape sawfly.

Doru lineare (Esch.) has been found in the flowers of *Inga laurina* in coffee groves in the mountains and is also reported as injuring the tips of vanilla leaves.

Labiidae

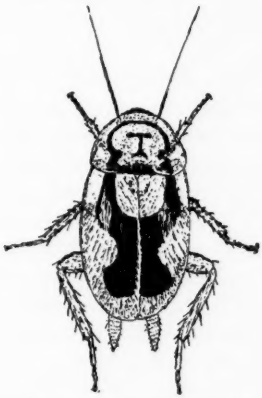
Labia curvicauda Motschulsky has been collected under the leaf-sheaths of sugar-cane, and under the base of coconut palm fronds still attached to the trees.

Labia dorsalis Burmeister was found in abundance under the bark of dead bucare trees, *Erythrina glauca*, at Cayey, where also Dr. Richard T. Cotton found in almost equal abundance the brachypterous form of **Prolabia unidentata** Palisot de Beauvois, which has only a single tooth on each jaw or tine of its forceps. A single specimen of **Prolabia arachnidis** Yersin, as determined by A. N. Caudell, has been collected on yautía.

ORTHOPTERA

Blattidae: Cockroaches

Cockroaches are certainly the largest and the most noticeable of the insects normally living as co-mensals in the houses with man in the tropics. But quite aside from these semi-domesticated, cosmopolitan species with which everyone must become altogether too familiar anywhere in the tropics, Puerto Rico is inhabited by many more wild endemic species. Most of these are wild to the extent that they normally live out of doors, but some of them seem to need a house of some kind to live in. Lacking a welcome in those of man, the little bright yellow **Aglaopteryx devia** Rehn



Adult of *Aglaopteryx devia* Rehn, three times natural size. (Drawn by F. Sein.)

is often to be found in the "nidos de mariposas", or butterfly-nests, which are formed in the leaves of the coffee shade tree, *Inga vera*, webbed together by the caterpillars of *Tetralopha scabridella* Ragonot. Where there are no butterfly-nests, it lives in abandoned spider-nests on the leaves of other forest trees. It is only in the dry climate of Mona Island where it was collected in 1913 by Mr. E. G. Smyth, that it can live comfortably under the bark of trees. Dr. Stuart T. Danforth (1926–97) found it in large numbers in the nests of the grey kingbird, in the region of the Cartagena Lagoon, "living among the twigs". Reported under the name *Ceratinoptera diaphana* F. by Mr. James A. G. Rehn (1910–73) from Culebra Island, it was subsequently described by him ("New or little known Neotropical Blattidae (Orthoptera)", Trans. Amer. Ent. Soc., **58** (2): 103–137, pl. 3, Philadelphia, April 28, 1932), the type from Aguadilla, Puerto Rico.

The type of **Aglaopteryx absimilis,** described by Dr. A. B. Gurney ("Studies in certain Genera of American Blattidae (Orthoptera)", Proc. Ent. Soc. Washington, **39** (5): 101–112, pl. 1. Washington, D. C., May 27, 1937) was a single male collected by Dr. Richard T. Cotton, living in the abandoned cocoon of the "plumilla", *Megalopyge krugii* Dewitz, on bucare trees at Cayey. On its prothorax are markings in black suggestive of the top part of a skull, and an even more complicated pattern in black is continued on its elytra, or on the body of the wingless nymph. It has since been found in a rotten wooden fence at Pt. Salinas, Palo Seco, and on the south side of the mountains between Cayey and Salinas living between leaves of *Samanea saman.*

Puerto Rican specimens of the brown-banded roach, **Supella supellectilium** (Serville), are practically unmarked, slender and graceful. In life, it is often associated, according to Mr. Francisco Seín (1923–8) with the German roach. As a *Blatta,* Dr. Gundlach "encontrado en las casas; Mayagüez", and all subsequent collections have been in hotels or houses.

Smaller and more slender than any of these house-inhabiting roaches are five species of *Cariblatta,* reported by Dr. Gundlach as *Blatta delicatula* Guerin that "viene muchas veces por la noche a las casas, atraída por la luz" and by Mr. Seín (1923–11) as *Blatella,* which he found living "between the leaves of sugar-cane and corn, probably feeding on the excrement of caterpillars and beetles". Three of these Mr. Morgan Hebard (Trans. Amer. Ent. Soc. **42** (2): 152–63. Philadelphia, 1916) included under the name **Cariblatta punctualata** P. B., and described **Cariblatta craticula,** the type from Mayagüez, others from Adjuntas. He also listed the collection of the Jamaican *Cariblatta reticulosa* Walker from Aibonito, but Mr. J. A. G. Rehn (Notulae Naturae, No. 149, pp. 1–15, Philadelphia, March 14, 1945) corrects the Hebard record of *reticulosa* from Puerto Rico by describing **Cariblatta hebardi;** thus removing *reticulosa* from the Puerto Rican list. In their ambitious and definitive publication entitled "The Orthoptera of the West Indies. Number 1. Blattidae" (Bull. Amer. Mus. Nat. History, **54** (1): 1–320, pl. 25. New York, September 9, 1927), Messrs James A. G. Rehn and Morgan Hebard describe **Cariblatta picturata,** the type from Adjuntas, others from Coamo; **Cariblatta plagia,** the type from Arecibo, others from Río Piedras and Manatí, and **Cariblatta stenophrys,** the type from Mayagüez, others from Adjuntas

The type of **Cariblattoides suave** Rehn & Hebard (1927–49 to 52) is from Aibonito, others from Arecibo and Río Piedras.

The type of **Neoblattella borinquenensis** Rehn & Hebard (1927–80 to 83) is from El Yunque, but others are from San Juan, Caguas, Manatí and Utuado, and that of **Neoblattella vomer** Rehn & Hebard (1927–83 to 85)

is Mayagüez, others from Adjuntas and San Juan. As an *Ischnoptera* Mr. A. N. Caudell described (Canadian Entomologist, **37** (7): 237. London, Ontario, 1905) **Neoblattella adusta** from Arroyo, this, or one of the others in this genus, possibly being what Dr. Gundlach listed as *Blatta vitrea* Brunner, or *Blatta caraibea* Saussure MS.

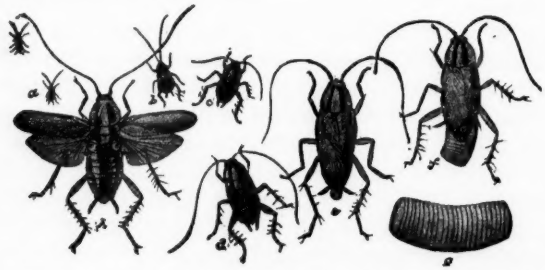
Symploce bilabiata Rehn & Hebard (1927–132 to 136), the type from Culebra Island, others from Aguas Claras, San Juan and Dorado, also occurs on Mona Island, where it was collected by Prof. J. A. Ramos. It is a somewhat larger, unmarked, light yellowish-brown cockroach, often found living under the leaf-sheaths of sugar-cane, and sufficiently abundant to serve as food for the crested lizard. The Hispaniolan **Symploce bicolor** Palisot de Beauvois, as identified by Dr. A. B. Gurney, has repeatedly been collected on Mona Island. The type of **Symploce flagellata** Hebard ("Studies in the Group Ischnopterites," Trans. Amer. Ent. Soc., **42** (4): 367, pl. 23, Philadelphia, 1916) is from Desecheo Island, others are from Mona, and Saona Island, Hispaniola, and, according to Rehn & Hebard (1927–136), this species "does not occur on the island of Porto Rico itself".

Considerably larger and darker than all the little wild yellow roaches previously mentioned is **Ischnoptera rufa rufa** (DeGeer), a continental cockroach originally described from Surinam, first reported from Puerto Rico by Carl Brunner von Wattenwyl ("Nouveau Systeme de Blattaires," p. 131. Paris, 1865), and as *I. rufescens* Beauvois by Mr. Rehn (1910–73) from Culebra Island. Rehn & Hebard (1927–112) note occurrence at Arecibo and Ensenada, but state that "none of the material was taken in forest conditions." Altho present at Río Piedras, and collected in fruit fly trap at Bayamón, this large cockroach is much more common in the mountains, being brought into houses on bunches of bananas, as at Lares, or flying into houses at night from the surrounding forest, as at El Verde in the Luquillo Mountains. One found dead, stuck to a leaf and covered with a green fungus, *Spicaria prasina* (Maubl.) Saw., as determined by Miss Vera K. Charles, was found at El Verde.

The type of the much broader, reddish-brown **Pelmatosilpha coriacea** Rehn was from El Yunque (James A. G. Rehn, "Studies in American Blattidae", Trans. Amer. Ent. Soc., **29** (3): 273. Philadelphia, September 1903), but has since been found quite common not only in the mountains but along the coast, and even on Mona Island. Under the loose bark of tortugo amarillo (*Sideroxylon foetidissimum*), it is very much at home.

The German cockroach, the light, yellow-brown, slender **Blattella germanica** (L.), may be distinguished by the dark-colored inverted "U" on its prothorax. Despite its small size and slender build, it appears to have conquered all of the tropical world, including even Mona Island. This is

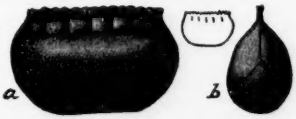
in part due to the habit of the female of always carrying her egg-cluster or oötheca with her until the eggs hatch, and also to the rapidity of growth of the nymphs, as was indicated by the investigations of Mr. Francisco Seín Jr. ("Cucarachas", Circ. No. 64, Estación Experimental Insular, pp. 3–12, fig. 9. Río Piedras, January 1928). Indeed, the nymphs develop so rapidly as to moult to adult within two months after hatching, and females appear with oötheca ten days later.



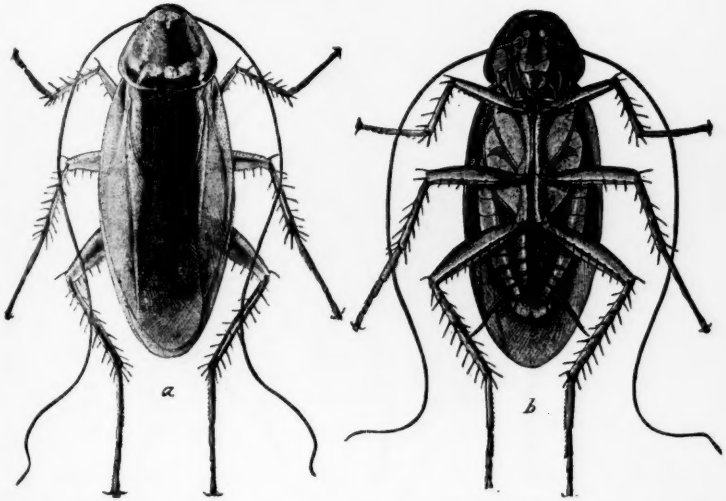
Blattella germanica (L.). All stages: egg to adult. Natural size. (After Riley.)

The much larger and more powerful domestic cockroaches, **Periplaneta americana** (L.), **P. australasiae** (F.) and **P. brunnea** Burmeister, have very definitely fallen behind in Puerto Rico in competition with the little German roach, especially since automatic kerosene, gas-powered and electric refrigerators have come into general use. The old-fashioned "real ice" refrigerators, of necessity had a drain for the escape of the water from the melting ice inside, and thru this, access to the interior was always available to the roaches. The new refrigerators have no such opening, and are absolutely tight, once the door is closed. Even if a cockroach, or ant, or any other insect, is accidentally introduced with food, it quickly finds an environment much too cold for comfort, rather than one gradually warming up as the ice melts. What this means in keeping food free from insects in the tropics can only be realized by one who has used both kinds of refrigerators: certainly one advance due to modern technology which nobody can criticise. But this seems to make little difference to the German roach, which disappears or appears in swarms as unaccountably and mysteriously in even the most scrupulously clean household, where the larger cockroaches never have a chance. Indeed, these larger roaches seem beset with enemies, for the females glue their oötheca to cracks in the wall, or in some other convenient crevice, and it is over a month before the nymphs hatch. During all of this time the egg-cluster is exposed to possible destruction by the careful housewife. Even in the most carelessly kept houses, or in garages or warehouses it is subject to attack by two parasitic wasps. The

shining black, nervous *Evania appendigaster* L., with a most surprising, short, triangular, stalked abdomen, is often seen in likely places looking for cockroach egg-clusters, of which an entire oötheca serves as nourishment for the development of but a single wasp. The much less obvious and much smaller *Tetrastichus hagenowi* Ratzeburg, another parasite of the



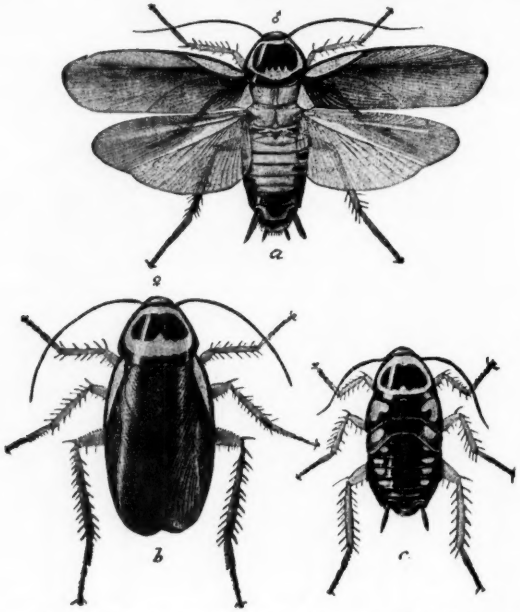
Oötheca of the American Cockroach, *Periplaneta americana* (L.), from the side and end, four times natural size. (After Marlatt.)



Periplaneta americana (L.), *a*. from above, *b*. from beneath. One and one-third times natural size. (After Marlatt.)

egg-clusters of *Periplaneta americana*, is often even more abundant. Many wasp larvae find nourishment for development in a single large cockroach oötheca. And if the nymphs of these large cockroaches succeed in hatching, despite the hazards to which they are exposed while in the unprotected egg-stage, they develop to adult with the most tiresome slowness even in the tropics. Mr. Sein found that the American roach required almost a year before finally moulting to adult, and the others at least five months. One more factor tending towards elimination is that the manufacturers of

the phosphorus paste, which, lightly spread on crackers, is so effective in attracting and killing cockroaches, now market their product in a collapsible tube, which greatly simplifies application to the crackers without getting the stinking poison on one's fingers. The general use of DDT sprays has also done much to rid houses of cockroaches, for altho they are not at once killed by anything weaker than a 10% application, the weaker applications against mosquitoes tend to make their haunts much less attractive. Mr. H. K. Plank, making tests with mamey-seed dust (Mayagüez Station

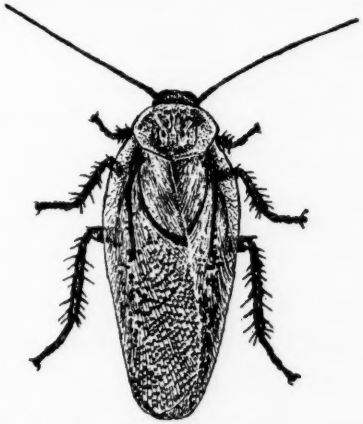


Periplaneta australasiae (F.), *a*. male, *b*. female, *c*. nymph. Natural size. (After Marlatt.)

Report for 1946, p. 12) found that adults of these larger roaches die in less than 20 hours when dusted with "a half-and-half mixture of technical sodium fluoride and wheat flour".

Of these three common, large reddish-brown domestic species, *Periplaneta australasiae* (F.) has a well-marked pattern in bright yellow on its prothorax, surrounding coalescing rounded areas; *Periplaneta americana* (L.) is more elongate, with the pattern on the prothorax much less sharp and with less contrasting coloration; while *Periplaneta brunnea* Burmeister has least pattern on its prothorax, is darkest in general coloration and is intermediate in size.

The very largest and darkest reddish-brown cockroach in Puerto Rico, **Nyctibora lutzi** Rehn & Hebard, described from Guánica (1927–193 to 194), with others from Utuado, is possibly to be found most often in the highest mountains, in rotten tree trunks. Some found at San Sebastián were in a large rotten stump which they shared with "comején" termites, yellow wood-ants and rhinoceros beetle grubs. Its distinctively large oötheca is elongated wedge-shaped, the little nymphs escaping by a hole eaten at the sharp edge of the wedge. As in the case of the large domestic cockroaches, growth of these nymphs is slow, over six months elapsing before they become adult. The nymphs may be distinguished by a covering of a milky mucilaginous substance covering the last two abdominal segments dorsally and the anal plates.



"La Cucaracha fatula," *Leucophaea maderae* (F.), natural size. (Drawn by F. Seín.)

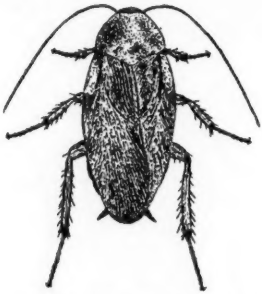
An almost equally large, speckled, yellow-brown species, "la cucaracha fatula", **Leucophaea maderae** (F.), is semi-domesticated, and is to be found most often in fruit stores or markets, sometimes in enormous abundance. From one little fruit store, the owner claimed to have cleaned out over a bushel of these cockroaches. They are not only gregarious, but the mother broods over her young, and together they sally forth at night in search for food, until they are of such a size as to mingle with their elders. When small, the nymphs are so transparent that the food eaten can be seen within their bodies, and growth is so slow that Mr. Seín found that it is often a year before they become adult.

Leurolestes pallidus (Brunner) was collected at Utuado by Dr. Wm. M. Wheeler, and has not since been noted.

The species of **Epilampra** collected at Utuado by Dr. Wheeler, and named for him by Rehn (1910–73), is a large yellowish-brown species with speckled

wings, and with difficulty distinguished from the more common low-land species, **Epilampra abdomen-nigrum** (DeGeer), which is abundant in wet malojillo meadows. Mr. Seín found it viviparous, the female giving birth to 35 to 50 nymphs at a time. The nymphs swim with ease and often remain beneath the water surface for long periods, as do also the adults. The type of **Epilampra mona** Rehn & Hebard (1927–216 to 218) was from Mona Island.

Pycnoscelus surinamensis (L.) is a broad, brown, medium-sized cockroach, so slippery that it does not so much run away as slip between debris, and easily eludes efforts at its capture. As *Panchlora*, Dr. Gundlach records that it "vive debajo de las piedras, tablas, etc.; también en las casas, en tierra". As a *Leucophaea*, Dr. Wetmore notes it having been eaten by the woodpecker. Rehn & Hebard (1927–243 to 245) found it on Mona



Epilampra wheeleri Rehn, slightly larger than life size. (Drawn by Francisco Seín.)

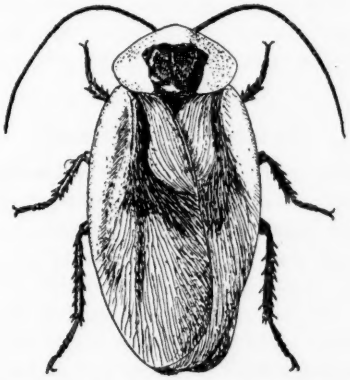
and Desecheo Islands. Altho primarily a xerophytic species: collected among dry stones on Mona Island, under dry cow dung at Boquerón, and under boxes at Guánica, it is reasonably common in the more humid parts of Puerto Rico, having been found by Mr. Seín under flower-pots in the garden at Lares. He reared the nymphs at Río Piedras in earth, feeding them on corn: the first, born on September 10th, 1922 becoming adult by the third of April in the following year, and the one slowest to develop becoming adult in June.

The beautiful light green cockroaches, of which, under the names *Panchlora viridis* F. and *Panchlora nivea* L., Dr. Gundlach notes the habits, "vive debajo de las cortezas sueltas de los árboles muertos, o debajo de las piedras, tablas, etc." They have since been identified as **Panchlora cubensis** Saussure. Rehn & Hebard (1927–251 to 254) described another as **Panchlora sagax,** the type from Dominica, others from Río Piedras, San Juan, Loíza, Adjuntas, Aibonito and Culebra Island. Sometimes individ-

ual adults are attracted to lights, but most have been collected from the very rotten interior of coconut palms. Mr. Seín, rearing the brown nymphs from two females, one from bananas, the other from rotten palm at Loíza Aldea, found that they became of full size in 100 days, and moulted to green adults despite having fed on the rotten brown fiber of the palm during all of their nymphal existence.

Aspiduchus deplanatus Saussure, noted by H. E. Crampton in limestone cavern at Corozal, "by thousands in grass and on walls", according to Rehn & Hebard (1927–279), had previously been recorded from Puerto Rico by Dr. Gundlach, "debajo de las piedras y de hojarasca".

Hemiblabera brunneri (Saussure) has short wings, covering but half the abdomen, dark reddish in color. The only recent collection is of a female found under the bark of a fence-post at Boquerón, who laid one cluster of eggs before her death in captivity. Under the name *Hemiblabera manca*, Saussure (Soc. Entom., VIII, p. 68. 1893) had described a male collected in Puerto Rico, and Mr. Aug. Busck had found a female on Culebra Island in 1899.



Blaberus discoidalis Serville. Natural size. (Drawn by F. Maximilien.)

Blaberus discoidalis Serville is a very large yellowish-brown cockroach with a broad black triangle on its exceptionally large and broad prothorax. It has been found mingled with *Leucophaea maderae* in fruit debris, but is by no means so abundant.

In contrast to these giants are the quite minute **Plectoptera dorsalis** (Burmeister) and **P. rhabdota** and **infulata** both described by Rehn & Hebard (1927–305 to 307 and 314 to 316) from Puerto Rico. All are light greenish-yellow when alive, living in trees between leaves, or in "butterfly-nests" of *Tetralopha scabiridella* in leaves of *Inga vera*, or of *Pilocrocis secer-*

nalis in the leaves of "capá blanco" (*Petitia domingensis*) in the mountains. Along the coast, they have been found under the bracts of cotton squares or bolls, and under the leaf-sheaths of sugar-cane, in curled-up leaves of grapefruit, or in the dry flower clusters of "espino rubial" (*Zanthoxylum caribaeum*). Those which he found living on leaves of "jobo" (*Spondias mombin*), Mr. E. G. Smyth thought must feed on "cast skins of Aleyrodids, thrips, Jassids, etc.". Under the name of *Plectoptera poeyi*, Dr. Wetmore records finding one of these little cockroaches eaten by the tody, and Mr. Rehn (1903–131) lists occurrence on Vieques Island. As *Plectoptera porcellana* Saussure, Dr. Gundlach notes that they "vive debajo de las cortezas sueltas de árboles muertos y vuela de noche a las casas atraída por la luz", and lists others under the name *P. unicolor* Burmeister.

The very smallest cockroach in Puerto Rico is **Holocampsa nitidula** (F.). Noted by Dr. Gundlach under the names *H. collaris* Burm. and *H. cyanea* Burm., "en las casas debajo de las tablas y otros objetos", one rarely finds them in houses in the mountains, in coffee groves or virgin forest. They are distinctively blue-black in color, with a large rounded orange-yellow spot on the wings. The pronotum of the female is orange in color, that of the male blackish, such an obvious difference that Burmeister, describing those collected on St. Thomas, gave them the separate names used by Dr. Gundlach.

Mantidae: Preying Mantids

The little green, pink or brown **Callimantis antillarum** (Saussure) is much more abundant in Hispaniola and on Mona Island than it is in Puerto Rico, and is often to be seen lying in wait for its prey on some outstretched frond of leaves. Little more than an inch in length, it is quick and active, and when pursued, only as a last resort does it seek safety in flight. Dr. Gundlach reports its occurrence "encima de la hierba de Guinea en Mayagüez", but it may rest on any kind of vegetation where it may catch smaller insects. Dr. Wetmore found that it formed part of the food of the kingbird, the ani and the mangrove cuckoo in Puerto Rico, and Dr. Stuart T. Danforth collected a mangrove cuckoo near Lake Miragoane, Haiti, that had eaten one.

The grey, speckled **Gonatista grisea** (F.) is more than twice its size; a clumsy monster sometimes attracted to lights, as terrifying to the stoutest-hearted man (or woman) as it is dangerous to any insect of reasonable size that comes within reach of its powerful front legs. Dr. Gundlach reports finding it "sobre los arbustos en la maleza y monte" and it has since been noted in a grapefruit grove at Pueblo Viejo, in a coffee grove at Lares, and attracted to light at Guánica.

Gonatista reticulata (Thunberg) has been recorded from Puerto Rico by Mr. A. N. Caudell (Psyche, **19** (5): 160-2. Cambridge, 1912), but none has since been collected here.

It might appear that the scarcity of preying mantids, both of species and of individuals, in Puerto Rico, is due to the relatively larger area of land under intensive cultivation, and to the number of people, even tho there would seem to be no possibility of direct competition with man. This is the more obvious when considering the extensive wilderness, desert or forested areas of Hispaniola and Mona, and despite the presence there

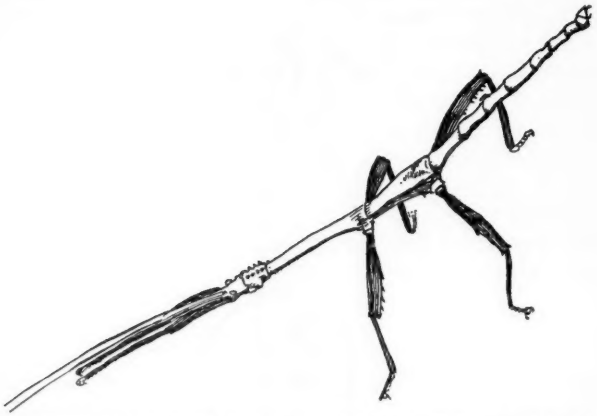
Epaphrodita musarum Palisot de Beauvois, an Hispaniolan Mantid, not reported from Puerto Rico, natural size. (Drawn by Fritz Maximilien.)

of an egg-parasite, *Podagrion texanus* Ashmead, which oviposits in the leathery egg-masses of *Gonatista*. Those of *Callimantis* in Puerto Rico are parasitized by an Eupelmid wasp: *Anastatus viridicaput* Gahan, and on Mona by a new species of *Anastatus* which has enormous clubbed antennae, even if its head is not green. Certainly nobody in Puerto Rico, except possibly the most ardent entomologists, would prefer that these fearsome creatures should be more numerous here.

Phasmidae: Walking Sticks

The walking sticks are as exclusively plant-feeding as the preying mantids are predaceous, and by their unique appearance, resembling twigs or moss-covered branches, should be even better protected against their natural

enemies. Indeed, the only reference to any Phasmid eaten by any bird in Puerto Rico given by Dr. Wetmore is of *Aplopus achalus* Rehn eaten by the mangrove cuckoo. Possibly because none of the walking sticks attacks any cultivated crop, all those which might possibly have been abundant in the level coastal areas, before they were brought under cultivation, are now scarce. The only exception appears to be that Phasmid attacking the tender leaves of the common shrub or small tree locally known as "cafeíllo cimarrón" (*Casearia sylvestris*), of which the most slender and fragile nymphs are often noted, but no adult has been collected on a plant identified



The Tupa *Lamponius*, natural size. (Drawn by G. N. Wolcott, original.)

as this host, and we can only guess that it is one of the species of *Dyme*. It may be, and probably is **Dyme haita** (Westwood), identified by Mr. A. N. Caudell, with *Bacunulus dryas* Westwood in synonymy, collected on shrubs at Bayamón and Caguas, and in a coffee grove at Lares.

This species is recorded by Messrs Harold K. Plank and H. F. Winters in their account of the "Insects and other Animal Pests of Chinchona and their Control in Puerto Rico" (Bulletin No. 46 Federal Experiment Station, Mayagüez, pp. 16, fig. 5, ref. 16. Washington, D. C., February 1949) as found "on the leaves of low bushy plants, *Pilea* sp., probably *yunquensis* (Urban) Britton & Wilson, growing nearby, and could be considered as at least a potential pest of *Chinchona*." Unidentified species of *Dyme* were found definitely feeding on the leaves of *Chinchona* in the nursery at Toro Negro, as well as a species of *Lamponius* and several species of *Antillophilus*, the only one identified to species being *Aplopus achalus*.

The types of both **Dyme krugiana,** described by Carl Brunner von Wattenwyl ("Die Ins. Fam. der Phasmiden", p. 324. Leipzig, 1907), and

of **Dyme yersiniana,** described as a *Bacteria* by H. Saussure ("Phasmidarum novarum species non nullae", Rev. et Mag. Zool., **20** (2): 65. 1868) were from Puerto Rico, the latter having been collected by Dr. Gundlach and listed by him as found "en los montes o malezas".

As *Bacteria spinosus* Burm., de Willem Haan ("Bijdragen tot de Kennis der Orthoptera", Verhand de Natur. Gesch. der Nederl. Overzeesch, Bezitt, etc., Orthoptera, p. 102. Leiden, 1842) records the presence of **Bacteria calamus** Fabricius in Puerto Rico.

The type of **Lamponius bockii,** described by J. Redtenbacher ("Die Ins. Fam. der Phasmiden", p. 357. Leipzig, 1908) is from Mona Island. No Phasmid, except one, has subsequently been collected on Mona.

As a *Pygirhychus*, Dr. Gundlach reports "hemos cogido solamente una larva" of **Lamponius guerinii** Saussure.

Between the Mt. Britton road and the point where the Mt. Britton trail meets the jeep road to El Yunque radar station, plants of what is locally known as "tibey" (*Tupa portoricensis*) may often be noted with some leaves eaten by what Mr. James A. G. Rehn considers to be a new species of **Lamponius.** Nymphs of all sizes and adults are possibly most abundant in autumn, but once one knows what to expect, at least adults may be seen at any time of year. These insects are characterized by resting with their head down, and forelegs and antennae extended and closely appressed, *down* the stem of the plant, but with the tail end up and curved over. All the nymphs are green, but adults may be green, grey or brown. The same, or another species, occurs on "camasey" (*Miconia guianensis*).

Phibalosoma ceratocephalum Gray, natural size. (Drawn by G. N. Wolcott, original.)

"Tibey" is also host for another Phasmid with a posterior rudder, spined and so covered with moss and lichen-like markings as to resemble a dead twig. The females are larger and stouter than the males, but otherwise in coloration, spines and posterior rudder, closely resemble the slender males. This is **Phibalosoma ceratocephalum** (Gray), a Brasilian species considered

by Redtenbacher to be the same as *Acanthoderus* (*Xylodus*) *adumbratus* which H. Saussure ("Orthoptera Novae", Rev. Mag. Zool., **9** (2): 62. 1859) named and described from specimens collected by Dr. Gundlach at Mayagüez. Despite the accurately descriptive character of the specific name used by Gray, as applied to the Puerto Rican horny-headed walking stick, Dr. A. B. Gurney doubts Redtenbacher's synonymy and implies the correctness of using Saussure's *adumbratus* for our local "tibey"-eating species.

Diapherodes longiscapha Redtenbacher (1908-435), the type from Puerto Rico, has since been collected on *Inga vera* at Lares, and repeatedly on weeds along the roadside up El Yunque, all of these having been identified by Dr. A. B. Gurney. The adult is bright green in color, five inches in over-all length, with a comparatively stout and somewhat spiny body, the rudimentary forewings being much larger than the minute hindwings. **Diapherodes gigantea** (Gmelin), (=*D. gigas* Drury) also occurs here, according to Mr. Caudell. Either may be *D. krugii*, Saussure's MS name for specimens collected by Dr. Gundlach at Mayagüez. The record from the Luquillo Mountains of *Diapheromera femorata* (Say), the common walking stick of the eastern United States, seems doubtful.

Aplopus jamaicensis (Drury), collected recently on *Inga vera* at Lares, has rudimentary wings, the front ones so small they hardly reach half-way towards the base of the somewhat larger hindwings. According to Redtenbacher, the *Aplopus achalus*, described from Puerto Rico by Mr. James A. G. Rehn (Proc. Acad. Nat. Sci., Philadelphia, **56**: 68. Philadelphia, 1904) may be in synonymy. Dr. A. B. Gurney considers that the **Aplopus** collected on Mona Island in March 1937 by M. A. Pérez may be a new species. In 1842, de Willen Haan recorded **Aplopus micropterus** (Lep. & Serv.) from Puerto Rico.

Anisomorpha jamaicana Redtenbacher, as doubtfully determined by Mr. A. N. Caudell, has been collected at Ponce.

Antillophilus restrictus, described by Redtenbacher as a *Pericentrus*, the type from Puerto Rico (1908-357), was subsequently found at Arecibo (James A. G. Rehn & Morgan Hebard, "New Genera and Species of West Indian Mantidae and Phasmidae (Orthoptera)", Trans. Amer. Ent. Soc., **64** (1): 33–55, pl. 2. Philadelphia, March 7, 1938).

Canuleius cornutus (Burmeister) is recorded by Haan from Puerto Rico, and **Clonistria linearis** (Drury) by Redtenbacher.

Tetrigidae: Pigmy Locusts

The pigmy locusts, at first glance, look like grasshoppers, but differ most obviously in the size of the pronotum, which is so long as to extend beyond the tip of the abdomen, thus taking the place of the forewings or tegmina, of which these grasshoppers have only small, scale-like, lateral vestiges.

A single common species occurs in Puerto Rico: **Paratettix frey-gessneri** Bolivar, present also on Mona Island. Of its habits, under the name *Tettix caudata* Saussure (a mis-identification), Dr. Gundlach says "en parajes húmedos, v. gr. al lado de lagunas". Rarely they are attracted to lights, but normally one will find these little dark brown or blackish locusts just where Gundlach indicates, in wet "malojillo" meadows, or at the edge of lagoons.

A less common species, **Micronotus quadriundulatus** (Redtenbacher), as determined by Mr. A. N. Caudell, has been collected once at Mayagüez.

Acrididae or Locustidae: Grasshoppers

Puerto Rico is either too wet or too dry for grasshoppers, possessing little of the semi-arid, uncultivated level areas of the great plains of the western United States, northern Venezuela and north Africa where these insects thrive. The dusty, dirty brown and somewhat plump **Sphingonotus haitiensis** (Saussure) is sometimes quite common in the areas, restricted in size, but typical in character, where grasshoppers thrive: on the margins of the lagoons of Guánica, Cartagena and Tortuguero, and on the airport landing on Mona Island. (Recorded by Messrs Rehn & Hebard (Trans. Amer. Ent. Soc., **64** (3): 212. Philadelphia, 1938) as Ensenada and Manatí, their new record being Coamo Springs.)

The more slender, green **Orphulella punctata** (DeGeer) has been collected in the garden at Guánica, and rarely at Mayagüez.

The larger **Rhammatocerus gregarius** (Saussure), brown with a sharply-defined yellowish-green stripe down the center of its back, has a much wider distribution in Puerto Rico, and is found in cane fields and pastures generally around the coast. As a *Stenobothrus* it was listed by Dr. Gundlach; as a *Plectrotettix* it is recorded by Dr. Wetmore as having been eaten by the green heron, the ani and the mocking bird, and by the writer (1924–11) eaten by the iguana, *Ameiva exsul:* and as a *Scyllina* has been noted as a minor pest of a sugar-cane and beans. In 1913 it was collected on Mona Island by Mr. E. G. Smyth, and has repeatedly been found there since. The nymphs have been noted feeding exclusively on the leaves of *Solanum persicifolium* on the cliffs between Isabela and the ocean, and not on other Solanaceous plants near-by, but it is doubtful if they are often this restricted in their choice of food. Adults have been collected on eggplant and tomato, which may be more attractive as food plants than grass and sugar-cane.

Schistocerca americana (Drury) is the largest grasshopper occurring in Puerto Rico and on Mona Island, many adults being two and three-quarters inches long, not including the antennae; **Schistocerca colombina** (Thunberg) may have some smaller individuals, but most are equally large, as is

also **S. pallens** (Thunberg). The observable differences between the species are slight. Dr. Gundlach lists them as *Schistocerca cancellatum* Serv., *S. obscurum* F., and *S. peregrinum* Olivier, and Dr. Stahl all in the genus *Acridium*. Mr. James A. G. Rehn (1910 76) uses the name *Schistocerca aegypta* Thunberg for his records of collection in Puerto Rico and on Culebra and Vieques Islands. The adults probably, and the nymphs unquestionably do feed on the leaves of sugar-cane, but the actual damage caused is negligible because of the normal scarcity of the insects. However, during dry winters, one may see the nymphs, entirely green in color, with a delicate bloom, gradually increase in size in fields of young cane from November to February, until the first yellow-brown adults appear in March. When adults are noticeable in December, one may expect a real outbreak by spring, as occurred at Yabucoa in 1943. Sugar-cane is not the only host, and pokeweed (*Phytolacca decandra*) is preferred, when available. These big grasshoppers look like real food to the larger birds, and Dr. Wetmore found their remains in the stomaches of the ani, the petchary and the kingbird. They are also eaten by the common ground lizard or iguana, *Ameiva exsul*.

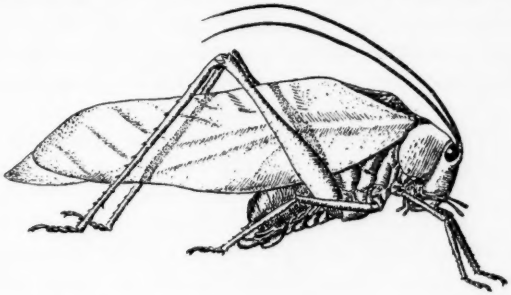
Tettigoniidae: Katydids

Microcentrum triangulatum Brunner is the common large, green, broad-winged katydid of Puerto Rico, found in all parts of the Island, as well as on Mona. The grey, leathery oval eggs are laid in a single row along the edge or midrib of almost any kind of leaf, and the nymphs hatching are varigated and bright-colored. In later instars they become mostly green except at the end of the longest segments of their legs, and at the angles of the wings, which are brown. In the last instar they are entirely green, like most adults. Some adults, however, are not green, and those feeding on bright-leaved Crotons are light yellow, stained a deep pink along the wing veins and where the chitinization is thickest. Both nymphs and adults feed on the leaves of many trees and plants besides those of Croton: rose bushes and flowers, cotton leaves and bracts, the leaves of grapefruit, moca, capá blanco, lignum-vitae and guaraguao having been definitely noted. Dr. Wetmore records only the mangrove cuckoo as feeding on this specific katydid, but notes that the sparrow hawk had eaten "a good many katydids". The writer has seen a hawk in Santo Domingo so repeatedly return to its perch with these katydids, from which it pulled off wings and legs, that dozens of these unwanted and inedible parts accumulated on the ground underneath.

The much less common, smaller, green **Turpilia rugulosa** Brunner is found around the coast, but we know little of its habits.

Anaulacomera laticauda Brunner is a more slender green katydid with narrow wings, found in coffee groves and forests of the mountains.

The largest of the narrow-winged katydids, or cone-headed grasshoppers, belong to the genus **Neoconocephalus,** of which **N. guttatus** (Serville) and **N. maxillosus** (F.) inhabit the high mountains. **Neoconocephalus obscurellus** (Redtenbacher), as a *Conocephalus*, was number 5 on Van Zwaluwenburg's list, presumably from Mayagüez or the Mayagüez region. The common low-land species is **Neoconocephalus triops** (L.), of which the green individuals are called var. **macropterus** Redtenbacher, and the brown ones var. **fuscostriatus** Redtenbacher. As *Conocephalus nieti* Saussure, Dr. Gundlach lists this species from Mayagüez. The ovipositor of the female is almost as long as all the rest of her body, and with it



The Hispaniolan Katydid, *Phoebolampta excellans* (Walker), natural size. (Drawn by Fritz Maximilien.)

she inserts her eggs far down in the central spindle of leaves of high sugar-cane. One egg-cluster, observed on Vieques Island, consisted of nine eggs, about half an inch long, light green in color and considerably flattened by the pressure between the leaf-sheaths. Adults often hide far down in the leaf-spindle of sugar-cane, but not necessarily anywhere near where they have been feeding, so that actual injury by either nymphs or adults can not be assessed with certainty. They are really very minor pests of cane, despite the large size of the individual. They are eaten by most of the larger birds; Dr. Wetmore reporting the green heron, the ani, the mozambique, mangrove cuckoo and flycatcher, and Dr. Danforth the grackle, the thrush and the sparrow hawk. The stomach contents of the judío and the clérigo (birds shot by Martorell) examined by the writer, in part consisted of their ungainly legs and wings. Mrs. Dexter found their remains in the stomachs of the imported toad, *Bufo marinus*. Adults often come to lights, usually singly, but sometimes in clouds, as in November 1944, not

only annoying but frightening movie patrons, as they fluttered about the brilliantly illuminated marqués in Santurce. On the roughened walls of the University buildings they found firm footing: hundreds of green and dozens of brown katydids coming to rest in the light, undisturbed by the passing of students.

The much smaller **Conocephalus cinereus** Thunberg, green with a broad brown dorsal stripe, is also found in sugar-cane, especially young cane, and in rice or similar coarse grasses, on Guinea grass on Mona (Ramos), and in "malojillo" meadows. When abundant, they may even attack tobacco seedlings, as at San Lorenzo in 1944, eating out rounded holes near the midrib. Their immobilized body often serves as food for the larvae of the Sphecid wasps, such as *Tachytes insularis* Cresson, *Prionoyx thomae* F., and *Ammobia dubitata* Cresson. Despite their active habits, they are caught and eaten by the little grass lizard, *Anolis pulchellus*.

Conocephalus fasciatus (DeGeer), number 4 on Van Zwaluwenburg's list as a *Xiphidion*, is recorded by Rehn (1910–76) from Vieques Island, but has only once since been identified from Puerto Rico.

The impressively large, spined, reddish-brown **Polyancistrus serrulatus** (Palisot de Beauvois), recorded from Puerto Rico by Carl Brunner von Wattenwyl ("Monographie der Pseudophylliden" *in* Der K. K. Zool. Botan. Gesell., p. 233, pl. ix, fig. 101. Vienna, 1895) actually does not occur here according to Mr. James A. G. Rehn "(The Hispaniolan Genus *Polyancistrus*", Trans. Amer. Ent. Soc., **62** (4): 272. Philadelphia, December 30, 1936), as there is no record of collection, even from Mona Island.

Of the large, reddish-brown nymphs identified by Mr. A. N. Caudell as a species of **Gryllacris**, collected from spider nest in curled-up leaves of an abandoned coffee grove at Indiera, no adult has ever been found.

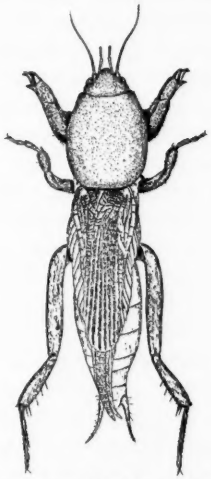
Phlugis virens (Thunberg) was re-described under the name of *Alogopteron caribbeum*, the type from Puerto Rico, by Mr. James A. G. Rehn (Entomological News, **14** (4): 141. Philadelphia, 1903), but has not since been collected here.

Gryllidae: Crickets

The "changa" or so-called Puerto Rican mole-cricket, **Scapteriscus vicinus** Scudder, is probably not endemic at all, but was accidentally introduced in commerce from South America, possibly in guano from Perú, and became a serious pest within the memory of Dr. Augustín Stahl. Under the name *Gryllotalpa hexadactyla* Perty, Dr. Gundlach wrote of it: "Esta especie abunda en Mayagüez y vuela muy frecuentemente a la luz de las casas. Vive en la tierra donde hace daño. Por la noche, principalmente después de un aguacero fuerte, deja oir un sonido muy

monótono, pero suave, producido por la fricción de sus alas; si uno se aproxima, cesa el sonido, pues el insecto percibe la pisada. Para cogerlo es menester aproximarse con sumo cuidado, averiguar donde suena y sacar con un golpe de guataca la tierra con el insecto." It occurs in abundance in all humid parts of the Island, more especially in the sandy regions, but appears even in the most xerophytic regions after heavy rains, and is present also high in the forested mountains.

The first economic account of "The Changa or Mole Cricket" is by Mr. O. W. Barrett (Bull. No. 2, P. R. Agr. Expt. Station, pp, 19, fig. 1. Mayagüez, 1902), and what was anticipated would prove the definitive



Adult Changa, *Scapteriscus vicinus* Scudder, twice natural size. (Drawn by F. Sefn.)

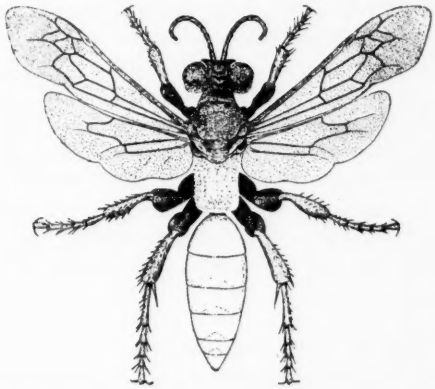
publication is by Mr. R. H. Van Zwaluwenburg: Bulletin No. 23 of the Mayagüez Station (pp. 27, pl. 3. Washington, D. C., 1918). Dr. Alexander Wetmore in his economic study of the food habits of the "Birds of Porto Rico" (Bull. No. 15, Board of Commissioners of Agr. P. R., also Bull. No. 326, (Professional Paper) U. S. Dept. Agr., pp. 1–140, pl. 10., many ref. Washington, D. C., March 24, 1916) found that the changa constituted over half the food of the Cuban green heron, and over a quarter of the food of the Puerto Rican sparrow hawk, nearly a sixth of that of the killdeer and a tenth of that of the spotted sandpiper. Studying the food habits of the "Birds of the Cartagena Lagoon" (Jour. Dept. Agr. P. R., **10** (1): 33–106, pl. 8. San Juan, January 1931), Dr. Stuart T. Danforth found that the changa is also eaten by the ani, the pied-billed grebe, and the

little blue heron. The common grass lizard, *Anolis pulchellus*, eats the small nymphs, but no lizard the adults. The Surinam toad finds the changa too nervous and rapid in its movements to be easily captured. Indeed, Mrs. Raquel R. Dexter's studies on "The Food Habits of the Introduced Toad, *Bufo Marinus*, in the Sugar-Cane Sections of Puerto Rico" (Bull. No. 74, Fourth Congress, International Soc. Sugar-Cane Technologists, pp. 6, ref. 6. San Juan, March 1 to 16, 1932) indicated that the changa constituted only 2.4% of its total food. All of these factors in natural control actually produce only a minor effect on its abundance. Artificial methods of control must be used if the farmer is to grow tobacco or vegetables on sandy land. Indeed, some land is so heavily infested with changas that no economic crop can be grown on it. Small scale experiments conducted in Georgia by Mr. W. G. Bruce (Jour. Ec. Ent., **39** (5): 662. Menasha, October 1946) indicate that such areas, at least temporarily, may be freed of the changa by applying a 1% DDT suspension in water at the rate of 5 gallons per 100 square feet. A comparable test, conducted on the lawn of the campus of the University of Puerto Rico indicated that the effect of the DDT, at least so far as the changa is concerned, lasts only about three months.

The effect of DDT is only temporary, and gradually changas tend to drift back to the treated area, so that in a few months as many may be present as before the chemical was applied. The action of chlordan and Aldrin (Hyman 118) is quite different, definitely killing the changas, which come to the surface to die, especially if rain has fallen after the application. In the morning after a rainy night, large numbers of their dead bodies will be seen on the ground, if not already picked up by chickens or insectivorous birds. Altho not all changas are killed in the first twenty-four hours, more and more die in the succeeding days as the chemical more thoroughly penetrates the soil. These chemicals have not been available long enough to indicate how long their residual effect will last, but against white grubs Aldrin shows no diminution in effectiveness after a year, and it is probable that its effect persists for a much longer period of time. Both are comparatively expensive, but they need to be used in only small amounts, as little as a pound and a half or two pounds per acre giving good results during rainy weather, with changas at the surface. Indeed, the principal difficulty in application is to spread such minute amounts of the insecticide evenly over the surface of the soil. In Florida, vegetable growers have been using enormous amounts of an inert carrier with 1% chlordan liberally applied to areas in which they expect to plant, but the same effect can be obtained with fertilizer, thus saving the expense of a separate application. Neither chemical is water soluble, but both may be obtained in technical form for mixture with fertilizer, as well as an emulsifiable concentrate or a

wettable powder. The absolute minimum amounts which can be used effectively have not been determined, but during dry weather, when changas remain deep in the earth, even excessive amounts are valueless. For use by vegetable growers, these new chemicals should entirely displace earlier methods of control of the changa, but for tobacco growers the historic method that has proved so effective in the past may be continued.

The practical method of artificial control, by making a ring around each transplanted tobacco plant of a mixture of 96 parts flour and 4 parts Paris Green, was discovered and used by Don Luis Sánchez of Comerío, quickly becoming a standard commercial practise adopted by most tobacco growers everywhere in Puerto Rico. First reported in 1915 as effective in "Control of the Changa" (S. S. Crossman & G. N. Wolcott, Circ. No. 6, pp. 3, Insular Experiment Station at Río Piedras), it was a positive means of destroying the insect, replacing mere protection of the plant at time of transplanting by wrapping with a mamey or seagrape leaf. Up to that time, this was the only method known, and indeed it is still used for the cheaper grades of tobacco. Of it, the numerous mamey trees still lining tobacco fields in the Cayey, Caguas and Comerío regions are a relic.



The changa parasite, *Larra americana* Saussure, introduced from Brasil, now established in Puerto Rico. Twice natural size. (Drawn by Francisco Sein.)

Symptomatic of the broad research basis on which the Experiment Station of the Hawaiian Sugar Producers' Association is conducted, is No. 19 of its Entomological Series Bulletins (pp. 179, fig. 16, pl. 34. Honolulu, 1928) entitled "Studies in Tropical Wasps—Their Hosts and Associates (with Descriptions of New Species)" by Dr. F. X. Williams. While searching for parasites of the oriental mole-cricket that had been

accidentally introduced into Hawaii, Dr. Williams spent some time at Belém, Pará, Brasil, and observed that *Scapteriscus vicinus* (a species which does not occur in Hawaii, and in which its sugar-producers have but the slightest interest) is parasitized by *Larra americana* Saussure. All of his observations are recorded at length, with numerous illustrations, and constitute a key for initiating a more perfect natural control of the changa in Puerto Rico. This parasitic wasp has been successfully introduced and become established in Puerto Rico, having extended its range all along the north coast and as far south as Humacao on the east and to Mayagüez on the west.

The changa is also attacked by a large yellow Tachinid fly, *Euphasiopteryx australis* Townsend, in northern Brasil, the importation of which into Puerto Rico has been attempted. Even under the most favorable climatic conditions in Brasil, however, only 2% of large changas are parasitized, indicating something of the difficulties attending such a project of parasite collection.

Brasil has giant mole-crickets, by comparison with which the inch-long changa that accidentally became established in Puerto Rico seems minute. But the changa is a giant by comparison with **Tridactylus minutus** Scudder, barely three-sixteenths of an inch long, hardly as large as some leafhoppers. Under the name *Tridactylus histrio* Saussure, Dr. Gundlach listed the Puerto Rican species, which occurs as well on Mona (Ramos), Cuba, and in México and much of the United States. Under the generic name of *Ellipes*, Dr. Wetmore records finding these little crickets eaten by the killdeer, the mangrove cuckoo and the martin. They are eaten also by the crested lizard, *Anolis cristatellus*, and the ground lizard or iguana, *Ameiva exsul*. By thousands, these little crickets may sometimes be seen making their burrows in the drying mud of ditches or along stream margins, or resting with only head and thorax exposed at the mouth of their tunnels.

Presumably they eat very small roots, but economically, any possible damage they cause is negligible.

Anurogryllus muticus (DeGeer) is a pale brown, ground cricket, which Dr. Wetmore found had been eaten by the ani, the owl, the oriole and the mozambique. It is also eaten by the crested lizard, *Anolis cristatellus*. It is normally by no means common, altho sometimes causing damage to tobacco and vegetable seed-beds. Dr. Gundlach collected specimens near Mayagüez, and Mr. J. A. G. Rehn (1910–77) found it on Culebra Island.

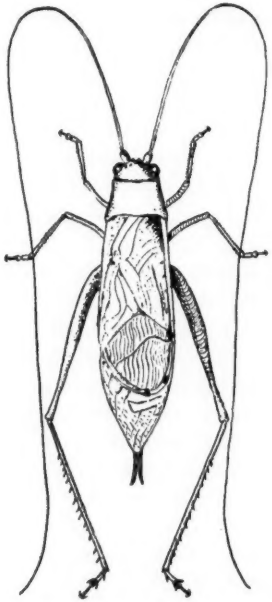
Much more abundant, somewhat larger and very much darker is **Acheta assimilis** F. Concerning this species, under the name *Gryllus aztectus* Saussure, Dr. Gundlach wrote: "Esta especie común y dañina en jardínes y huertos. De día está escondido y de noche sale a comer. Emite un

sonido fuerte en proporción al tamaño de su cuerpo, incomodando si ha llegado a un dormitorio." Dr. Wetmore found them eaten by the green heron and the ani, and Dr. Danforth by the sparrow hawk. Mrs. Dexter found them eaten by the introduced toad, but, when the food of lizards was being studied, possibly due to the accidents of collection, they were found only in the stomachs of the skink, *Mabuya sloanii*. Since these crickets cause much the same kind of damage to vegetable plants and tobacco seedlings as do cutworms and changas, it is possible that much of their injury is charged to these more familiar insects. We have definite records of attack on tobacco, both roots, stems and leaves, and on onions, beans and cotton. In a seed-bed of Australian beefwood (*Casuarina equiselifolia*) at Humacao, they continued attack until the trees had attained considerable size. Mr. Seín noted these crickets cutting off carnation flowers and pulling them into their tunnels in the ground. During dry weather, and in xerophytic regions, as at Guánica, Boquerón and on Mona Island, the crickets will feed on fresh cow dung, and hide under the slabs when they are hard and dry.

The terrific noisy racket that commences at sunset on El Yunque, and continues all night long until daylight, is as annoying to the town or city-dweller of Puerto Rico as that of the "L" in Chicago or New York to any farmer. Even in the man-made forest of a grape-fruit grove, the combined efforts of the tree-toads and all the various kinds of Orthoptera produce an overpowering din that shames the noisiest nightclub. A single tree cricket alone, by the very persistence of its shrill cry thru the night, can keep one awake for hours, if it happens to stray into town. If it happens to enter your bedroom, every effort should be made to effect its capture and silence its shrill cry.

Beautifully slender, light brown, the forewings margined with bright yellow, **Orocharis vaginalis,** the type from Puerto Rico, described by H. Saussure (*in* "Orthoptera", Biologia-Centrali Americana, p. 276. 1879) and **Orocharis terebrans** Saussure (1879–277), the type also from Puerto Rico, are the most common and representative of the tree crickets. Nymphs and adults feed on the leaves of grapefruit and coffee, making characteristic lesions along the midrib. The actual damage is negligible, and they mostly serve as nourishment for such retiring birds as the mangrove cuckoo, wood pewee and the oriole, as noted by Dr. Wetmore. On Mona Island, *Orocharis vaginalis* found a suitable environment in the rank growth of wild cotton beneath the cliffs, comparable to that on the ornamental *Dracaena fragrans*, at Río Piedras, observed by Mr. Seín. On such ornamentals, the irregular lesions to the undersurface of the leaves are distinctly detrimental, insignificant as they may be in the grapefruit or coffee grove.

The cylindrical, dark grey **Laurepa krugii** Saussure, listed by Dr. Gundlach as an *Apithis*, is scarce, but occurs in all parts of Puerto Rico, having been found in coffee groves at Adjuntas and in the mountains north of Ponce, in grapefruit grove at Bayamón, and in the mangrove swamp at Boquerón. Mr. Pedro Osuna found it a serious pest in his little coffee grove at La Muda, chewing elongate gouges in the woody stems of coffee and other plants.



Male Adult of the common Tree Cricket, *Orocharis vaginalis* Saussure, twice natural size. (Drawn by Fritz Maximilien.)

The type of **Diatrypus sibilans** Saussure, H., ("Melanges Orthoptérologiques", Fasc. 6, pp. 702–703. Geneva, 1878) is from Puerto Rico, but no specimen thus identified has since been collected.

Phalangopsis guerrina Saussure is listed by Dr. Stahl.

The continental snowy tree cricket, **Oecanthus niveus** (DeGeer), was found by Prof. J. A. Ramos (1947–11) on Mona Island. This species appears to be unknown from Puerto Rico, but Mr. A. N. Caudell identified a cricket collected at Villalba as a species of **Paroecanthus.**

Hapithus tenuicornis (Walker), a xerophytic species present also in Hispaniola has short brown wings that hardly more than half cover its

darker brown abdomen. Many flew to the light on top of the Casa Grande at Hda. Santa Rita, Guánica where they were collected by Mr. E. G. Smyth.

As *Gryllodes poeyi* Saussure, Mr. James A. G. Rehn (1903–135) records **Gryllodes sigillatus** Walker, not since found in Puerto Rico, and also **Anaxipha pulicaria** Burmeister, and **Cyrtoxipha imitator** Scudder.

The very small green tree cricket, **Cyrtoxipha gundlachi** Saussure, noted by Dr. Gundlach "en las cercanías de Mayagüez", and listed by Van Zwaluwenburg, is sometimes attracted to light, but is more often noted on vegetation: sugar-cane, corn, citrus, banana and eggplant all having been noted as temporary hosts. Prof. J. A. Ramos found it on Mona Island.

Mr. A. N. Caudell identified as **Stenogryllus** a female tree cricket an inch and a half long, light purplish brown in color, collected at Aibonito in a coffee grove, and another in the rotten twig of "cobana negra" (*Stahlia monosperma*) in the swamp at Boquerón.

Moving into a house that has been vacant for some time, one will usually find that crickets have pre-empted claim to a place (not in the sun, but) in the darkness. These cave crickets, **Amphiacusta caraibea** Saussure, of which one will find the gigantic adults still living in caves in Puerto Rico and the near-by islands, seem rarely to have a chance to attain full size in houses, but the sprightly nymphs give one lots of sport, for they jump at you if you try to catch them. Dr. Roman Kenk found them exceptionally abundant in the caves at Aguas Buenas, and considers them as the most probable food for the tailless scorpions or "guabás" that inhabited the walls and ceilings. The crickets doubtlessly fed on the debris and seeds dropped by the bats after they had consumed the fleshy portions. Dull brown in color, they have the slenderest of long legs, and antennae almost twice as long: the longest antennae of any Puerto Rican insect. The short, rounded wings of the adults barely cover half the abdomen and apparently are no longer functional. In houses, the kitchen and bathroom most often harbor these crickets, and they are fond of rattling the papers in a waste-basket, especially if one has carelessly thrown the bread-wrapping and the bread crumbs there. Outdoors, they sometimes attack vegetable and tobacco seed-beds, causing damage comparable to that of the changa or the field cricket, *Acheta assimilis* F., and are to be controlled in much the same way, by the Paris Green and flour mixture. At Humacao, seed-beds of the introduced Australian beefwood (*Casuarina equisetifolia*) were attacked, injury continuing until the seedlings had begun to develop woody stems. Both Van Zwaluwenburg (1918–26) and Cotton (1918-270) discuss the economic aspects of what the latter calls the "sick cricket"—"Nocturnal in habit, hiding during the day under trash or in cracks in the soil and coming out at night to feed." Unquestionably these crickets were present

when Dr. Gundlach was in Puerto Rico, but the first mention is by Mr. James A. G. Rehn (1910-77), who collected them from caves near Pueblo Viejo and San Juan, on El Yunque, and on Culebra and Vieques Islands. They are common in the caves and in the bathrooms of the seldom-inhabited cottages on Mona Island, and have been noted in abundance hiding under coconut husks on the beach at Arecibo.

ISOPTERA: Termites

Kalotermitidae: Dry-Wood Termites

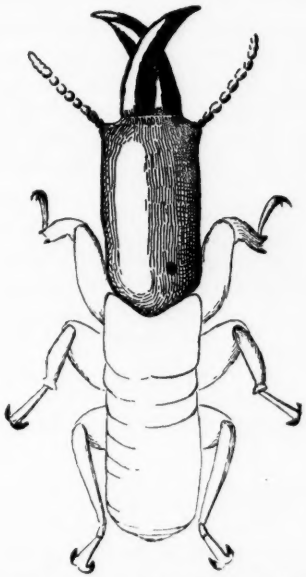
Mona Island harbors one unique endemic dry-wood termite, **Kalotermes (Neotermes) mona,** described by Prof. Nathan Banks in his "Antillean Isoptera" (Bulletin Museum of Comparative Zoology, **62** (10): 475–489, pl. 2. Cambridge, January 1919) from soldiers, which have distinct black eyes. Who collected these soldiers is not recorded, but on April 5, 1944, Jorge Serrallés and Luis F. Martorell found a colony containing winged adults in a rotten fence post, and J. A. Ramos another colony in the broken branch of "quenepa" (*Melicocca bijuga*). The colony consists of comparatively few individuals, but both soldiers and adults are of large size, exceptionally large for the West Indies. Since the winged adults have been found, Dr. T. E. Snyder was able to place the species in the subgenus *Neotermes.*

Kalotermes (K.) snyderi Light is very abundant on Mona, occurring in dead fence posts and even in the timbers of the lighthouse, but most commonly in dead branches of trees, such as seagrape or "uva de playa" (*Coccoloba uvifera*), "uvilla" (*Coccoloba laurifolia*), "sanguinaria" (*Dipholis salicifolia*), buttonwood or "mangle de botón" (*Conocarpus erecta*), milkbush or "palo de muñeca" (*Rauwolfia nitida*), and the characteristic endemic poisonwood or "papayo" (*Metopium toxiferum*). If lumber on Mona was worth anything more than for firewood, this would be a serious pest, as it is in the southeastern United States, Central America and some of the West Indies. Possibly because of competition, it is not abundant in Puerto Rico, most colonies being found in lumber also infested by other termites such as the omnipresent "polilla". The soldiers have no noticeable eyes, and the winged adults are very light-colored. The eggs are oval and whitish, the excrement pellets are barrel-shaped, with four or five darker depressions on the sides. The earlier records from Puerto Rico were reported under the name *Kalotermes marginipennis* Latreille.

One other termite present on Mona, tentatively identified by Dr. Alfred Emerson as **Kalotermes incisus** Silvestri from material collected by Prof. J. A. Ramos in August 1944, was reported by him in "The Insects of Mona Island, West Indies" (Jour. Agr. U. P. R., **30** (1): 1–74, pl. 2, ref. 45. Rio Piedras, 1947). This was originally described from Venezuela in 1903.

Since its original description by Burmeister as a *Calotermes*, the record by Dr. Stahl and the note by Dr. Gundlach: "Vive escondida dentro de las maderas muertas", **Kalotermes (Neotermes) castaneus** has not been collected in Puerto Rico.

Kalotermes (K.) cavifrons (Banks), as determined by Dr. T. E. Snyder, occurs in a house on the grounds of the Experiment Station at Mayagüez, (Report for 1942, p. 14), having been first noted in 1936.



Soldier of *Kalotermes* (*K*). *snyderi* Light, ten times natural size. (Drawn by G. N. Wolcott.)

Economically, the most important termite of Puerto Rico is the dry-wood species commonly known as "polilla de madera", or simply "polilla", and scientifically as **Kalotermes (Cryptotermes) brevis** (Walker). Its gauzy-winged, brownish adults swarm about lights in houses during May and June, and a few are to be found at any time of the year. Breaking off their wings, they pursue each other in a constantly interrupted game of "follow the leader", in which every termite wants to follow. Most of them fall prey to nocturnal lizards, or to any house-inhabiting ant, but a few crawl into crevices in wooden houses, the wooden trim in concrete houses, or burrow into furniture, the rockers of chairs, between the caning of

"solid mahogany" chairs hiding parts made of some susceptible wood, into the binding of books, or the folds of undisturbed papers or magazines, or the back of picture-frames on the wall, and there start a colony. Furniture made entirely of West Indian mahogany (*Swietenia mahagoni*) heartwood is immune to their attack, but nymphs from well-established colonies will eat deep gouges into mahogany heartwood when searching for new worlds of susceptible wood to invade, and penetrate to the outside of thin sheets of mahogany plywood. The heartwood of Honduras mahogany (*Swietenia macrophylla*) is no more resistant than the sapwood of the West Indian species, and the so-called mahogany of the Philippines (*Shorea negrosensis*), and that of Africa (*Khaya ivorensis*), are very susceptible to attack. So also are all the woods of the temperate zone thus far tested, except Osage orange (*Maclura pomifera*). Coniferous softwoods, such as southern cypress, red cedar and West Indian pine, with their heartwood heavily impregnated with their natural resinous gums, are resistant, but even the

Soldier of *Kalotenmes* (*Cryptotermes*) *brevis* (Walker). Eight times natural size. (Drawn by G. N. Wolcott.)

heartwood of the same species lacking an abundance of natural oils and gum is readily eaten. Most of the common woods of Puerto Rico are as susceptible as any of those imported, but the native hardwoods commonly used for making native furniture are almost as resistant to attack as is mahogany, and "guayacán" (*Guaiacum officinale*), "mora" (*Chlorophora tinctoria*), "maga" (*Montezuma speciosissima*), and "algarrobo" (*Hymenaea courbaril*) are even more so.

"A List of Woods arranged according to their Resistance to the Attack of the West Indian Dry-Wood Termites, *Cryptotermes brevis* (Walker)" (Caribbean Forester, **7** (4): 329–336. Río Piedras, October 1946) gives the following preferred native hardwoods in the order of their approximate desirability after mahogany: albizia (*Albizzia procera*), úcar (*Bucida buceras*), cedro hembra (*Turpinia paniculata*), cóbana (*Stahlia monosperma*), aroma (*Vachellia farnesiana*), aceitillo (*Zanthoxylum flavum*), ausú (*Amomis caryophyllata*), caracolillo (*Homalium racenosum*), ortegón (*Coccoloba rugosa*), moralón (*Coccoloba grandifolia*), guaraguao (*Guarea*

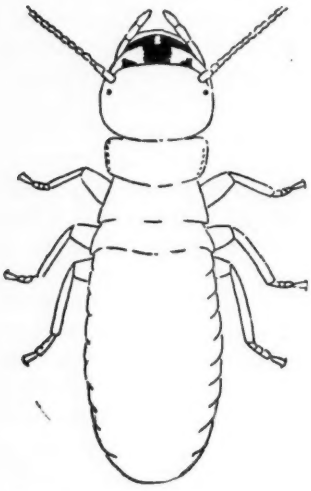
trichilioides), granadillo (*Buchenavia capitata*). The beams of capá prieto (*Cordia alliodora*) in the recently repaired Governor's palace have survived for hundreds of years without being attacked, altho controlled experiments show capá as much less desirable than mahogany, and at the very end of the list of resistant woods. Ausubo (*Manilkara nitida*), cedro macho (*Hyeronima clusioides*), cacao motillo (*Sloanea berteriana*) are susceptible woods, the one at the end of the list being laurel sabino (*Magnolia splendens*). Tabonuco (*Dacryodes excelsa*) is very susceptible, and should never be used to replace mahogany.

The outside surfaces of even the most termite-susceptible woods may be made immune to termite attack by chemical treatment; an ounce of zinc chloride or copper sulfate in a gallon of water being a more than ample concentration to protect even such susceptible woods as almácigo and flamboyán. The fluorides of zinc and copper are effective at even greater dilutions, but dissolve with difficulty, even in boiling water. Copper ammonium fluoride, $Cu(NH_3)_4F_2$, recently developed by the Whitemarsh Research Laboratories of the Pennsylvania Salt Manufacturing Company, is supplied in a concentrated aqueous solution containing over 14% metallic copper and approximately 9% fluorine. It changes on drying to form insoluble copper fluoride, staining the treated wood light blue. As noted in "The Caribbean Forester" **10** (3): 197–203. Río Piedras, July 1949, dry-wood termites will not eat wood impregnated with 0.02% Cu as copper ammonium fluoride: a dilution of the concentrate with seven or eight hundred times as much water. It would appear to be by far the most economical chemical for protection against termite attack. Other repellent metals are mercury, cadmium, ferric iron, antimony and aluminum.

The lack of "Permanence of Termite Repellents" (Jour. Ec. Ent., **40** (1): 124-9. Menasha, February 1947) shown by some inorganic chemicals is practically universal among the organic compounds, and only time will prove which can provide protection approximating the service life of the wood anticipated where termites are not present. The lead, sodium, zinc and copper salts of pentachlorphenol are much more repellent than the widely advertized pentachlorphenol itself, as are also pentabromophenol and hexachlorphenol. The gamma isomer of benzene hexachloride is temporarily very much more effective than the alpha and beta isomers, but wood impregnated with 2% gamma isomer is eaten in less than a year while comparable samples treated with 2% DDT and 2% pentachlorphenol are still immune from attack more than six years after impregnation. Tectoquinone, present in East Indian teak (*Tectona grandis*), is not only responsible for the natural resistance to termite attack of this wood, but is available commercially for protecting susceptible woods. Xanthone and

α-Naphthoflavone are more repellent than tectoquinone. Despite the comparative inefficiency of pentachlorphenol and DDT, these two will doubtless be most extensively used in the near future, mainly because of ready commercial availability.

Some months after the male and female adult of *Cryptotermes brevis* become established in their tunnel in wood not treated to prevent their entrance, the female begins laying eggs. These are of an elongate kidney-shape, firm, plump and shining, finely reticulated and pinkish in color:



Nymph of *Kalotermes* (*Cryptotermes*) *brevis* (Walker). Eight times natural size. (Drawn by G. N. Wolcott.)

De-alate adult of *Kalotermes* (*Cryptotermes*) *brevis* (Walker). Six times natural size. (Drawn by G. N. Wolcott.)

pearly opalescent jewels of eggs. The nymph which hatches is colorless and semi-transparent, and is fed upon a blanc-mange of finely chewed-up wood, from which it graduates only gradually as it grows and moults. The moults are easily distinguished up to the fourth by progressively increasing head-sizes, and there is at least one more moult when the fully-grown nymph acquires wing-pads half the length of its body, or a very few of them moult to soldiers.

The soldiers hold the Maginot Line for the colony, inserting their head in the hole to the exterior between the intervals when the excrement pellets

are shot out of it, when the tunnels of the colony have become too crowded for comfort. These pellets are of characteristic lozenge-shape, with their two broadest surfaces slightly concave, and are as hard and dry as the wood the termites have been eating. The color varies, as colonies living in southern pine may produce some that are semi-opaque reddish-brown, while others are cream or buff. Those colonies which live in wood devoid of gum have pellets of uniform color, grey or light brown. The amount of excrement produced depends upon the palatibility or digestibility of the food: half of those woods which are high in cellulose reappearing as excrement pellets. Termites forced to eat mahogany heartwood get little nourishment out of it, 90% of the weight of the eaten wood becoming excrement, even tho less than half of it is indigestible lignin. In attaining full size, a termite nymph eats eight to ten times its live weight of wood, winged nymphs weighing approximately 0.0034 gr. each. De-alate adults weigh approximately 0.005 gr., and for maintenance alone in nine months eat six times that weight of wood.

Once established, theoretically the colony is immortal. Even if the female who founded it dies, the older nymphs take over egg-laying, their bodies becoming much distended, as hers never did. Often a colony dies out as its food supply approaches exhaustion, as in picture-frames and small articles of furniture. A building in which a colony becomes established is subject to repeated reinfestation every succeeding spring by fresh waves of adults from the original and daughter colonies, not counting all those which fly off to attack uninfested wood elsewhere. Indeed, *Cryptotermes brevis* has become so omnipresent in Puerto Rico as to be a vital factor to be considered in planning houses or purchasing furniture. "What to do about Polilla" (U. P. R. Agr. Expt. Station Bulletin No. 68, pp. 29, fig. 3, ref. 5. Rio Piedras, February 1946) is a problem facing everyone. Control in heavily infested houses or furniture is hopeless, as the wood is already so weakened by their attack as to be practically valueless, even if the termites inside it are killed. The remedy is indicated by the increasingly common use of cement construction for all permanent buildings, and of solid mahogany heartwood and similar resistant tropical hardwoods for furniture.

The high humidity and lower temperatures of El Yunque do not prevent termite attack on wooden buildings, **Kalotermes (Glyptotermes) pubescens** Snyder having been repeatedly found attacking the cottages built of native woods in the Sierra Palm recreation area, and the stumps of trees from which the timbers used in construction had been cut. This termite was originally described (Proc. U. S. National Museum, **64** (2496): 10–12, pl. 2. Washington, D. C., 1924) from a colony living in the dead top of a live coffee tree at Aibonito, and it has since been noted living in dead wood at

Cayey. The type of **Kalotermes (Calcaritermes) corniceps,** originally described by Dr. T. E. Snyder as a *Glyptotermes* (Proc. Ent. Soc. Washington, **25** (4): 91–93, pl. 1. Washington, D. C., April 1923), and most recently placed by Dr. Alfred Emerson in the subgenus **Procryptotermes,** was found in a small tree at Boquerón. It has since been collected on Mona Island, at light and a colony in an old stump by Prof. J. A. Ramos.

Rhinotermitidae: Subterranean Termites

Of subterranean termites (Rhinotermitidae), Puerto Rico has but two common species: **Heterotermes convexinotatus** (Snyder) and **H. tenuis** (Hagen). Until recently, the damage caused by them has been negligible, but in recent years has become much more serious. Colonies have destroyed an entire block of houses in Aguadilla, and the ground under the public school at Naguabo is so heavily infested that all wooden trim and cloth or paper supplies left there during vacation time is found destroyed when the school opens again. Due to heavy infestation of the ground occupied by the U. S. Naval Radio Station in Puerta de Tierra, wooden structures were replaced by new ones of concrete. The Ateneo Building in San Juan has had wooden floors repeatedly replaced, the infestation being so heavy that even the live hibiscus plants surrounding it have their wooden stems hollowed out. The most interesting manifestation is of tunnels appearing from between the ceiling and the picture molding out of cracks on the second floor of the main administration building of the University of Puerto Rico. In a country subject to earthquake shocks, even the best of present construction may develop cracks, which the lime-dissolving saliva of subterranean termites widens sufficiently so that their narrow tunnels can penetrate. From the ceiling, stalactite-like tunnels are built down to any wooden member, or to furniture resting against the wall. Of such insidious attack, not even a flight of adults gives previous warning. Since entrance in large buildings is within the walls, or inside the building, the efficient application of chemicals, such as sodium arsenite, or coal-tar creosote, or pentachlorphenol, or fumigants such as orthodichlorbenzene or chlorpicrin, is much more difficult than in buildings that have a basement. When the termites gain entrance to a concrete building in which wooden members extend thru the floor to the earth beneath, the removal of such structural means of easy approach should eliminate the infestation. All weaknesses and deficiencies in construction are discovered by the termites, which may repeatedly gain entrance to buildings, as in the School of Tropical Medicine at San Juan, around water mains or pipes, ground wires, or even in the corners of dark closets imperfectly floored with tile. For a building in infested areas, construction must be comparable to that of the hull of a boat, if entrance of these most persistent termites is to be prevented.

Soldiers of **Prorhinotermes simplex** (Hagen), as identified by Dr. T. E. Snyder, were discovered by Mr. Francisco Seín in August 1944 at Río Piedras in breaking open a "comejenera" of *Nasutitermes costalis* on a living aguacate tree. When this nest was removed, many additional soldiers and workers were found in the rotten wood. The slender, curved jaws of the soldiers, with smooth, un-toothed margins, are very different from the powerful jaws of the soldiers of *Heterotermes*.

Tenuirostritermes discolor was described by Prof. Nathan Banks (1919-489) as a *Constrictotermes* from soldiers taken at Manatí, Adjuntas, El Yunque and on Culebra Island, and it has since been found in rotten palm stump at Guavate Camp, Cayey and in rotten stump or trunks of *Inga vera* in coffee groves at Ciales and Lares. No external nest is constructed, but the interior of a rotten stump is hollowed out and lined with very dark brown termite building material, runways extending to other parts of the tree trunk under the bark. It is one of the more common termites of the coffee groves and high mountains, attacking trees that are entirely dead, and not the dead and dying portions of live trees, as does *K. (Glyptotermes) pubescens*.

Tenuirostritermes wolcotti is a "small, dark species, with a hairy, fairly prominently constricted head" of which Dr. T. E. Snyder wrote the "Description of a New Termite from Puerto Rico" (Proc. Ent. Soc. Washington, **26** (5): 131–2, fig. 1. Washington, D. C., May 1924) from material found at Boquerón in dead wood of "úcar," *Bucida buceras*, November 7th, 1923. No nest was present, but tunnels sometimes as much as an inch in breadth extended up from the ground over the dead wood. They were constructed almost entirely of reddish soil, with apparently little organic content. No subsequent collection of this termite has been made in Puerto Rico or elsewhere.

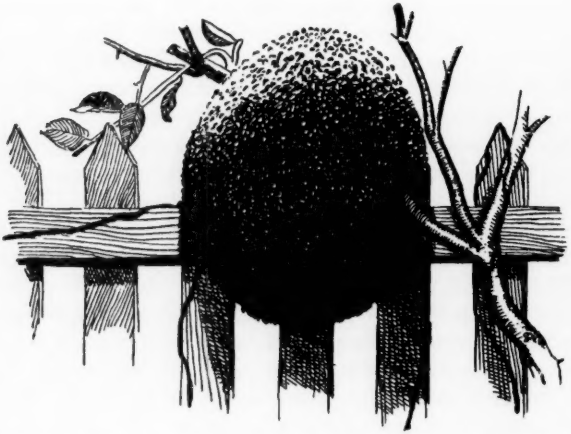
Microcerotermes arboreus Emerson (as *Eutermes debilis* Heer) "was described from specimens in gum-copal and Hagen identified it with specimens from Porto Rico" according to Prof. Banks (1919–482), the material having been collected by Dr. Gundlach and listed by him and Kolbe. It has not since been found locally. Prof. Banks states that "doubtless *Eutermes theobromae* Desneux, from St. Thomas, is the same species."

Termitidae

The large aerial "nigger-head" nests or "comejeneras" to be seen on dead fence posts, or on live trees along highways, especially on flamboyáns, are the most typical expression of the activities of the most common representative of the Termitidae in Puerto Rico: **Nasutitermes (N.) costalis** Holmgren (= *N. morio* Latreille, = *N. sanchezi* Holmgren). This is the cosmopolitan species present in all the larger West Indies, but is not known to occur on Mona, Desecheo or Culebra. Near Pt. Arenas, Vieques

Island, an exceptionally large "comejenera" was observed in 1940, and for many years one almost as large survived on a mamey tree close to the road at Martín Peña. They rarely attain large size in the more densely inhabited parts of Puerto Rico at the present time, furnishing a too tempting target for boys with stones, and farmers cut them down to furnish animal food for chickens.

On some breathlessly hot late afternoon or early evening, just before the approaching storm breaks in May or June, thousands of black winged adults crowd out of the nest. Lizards soon tire of the feast they provide, but ants seem unwearying in returning to the attack. The cook fumes be-

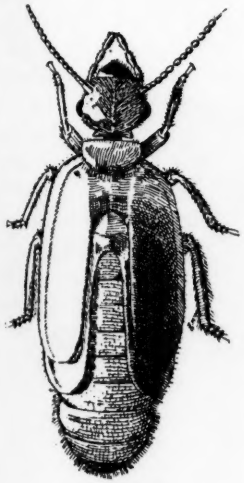


"Nigger-head" nest, or "comejenera" of *Nasutitermes* (*N.*) *costalis* Holmgren. (Drawn by G. N. Wolcott.)

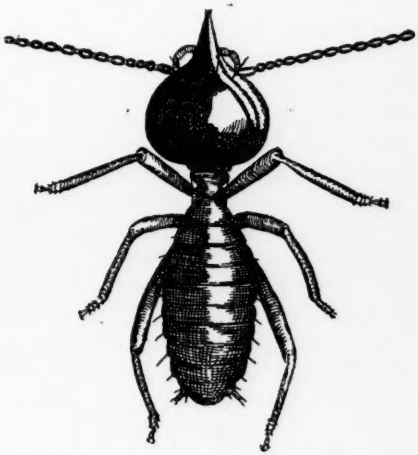
cause they fall into whatever she holds near the light, and dinner is eaten in semi-darkness, if one is to avoid fishing numerous helpless bodies and detached wings out of the soup. No urge to survive seems to animate the adults, and, judging by the number of new nests each year, less than one in a million escapes the numerous perils besetting them. The evidence as to how a new colony is started is based on finding in a rotten twig of "achiote" (*Bixa orellana*) at Lares in mid-June 1921, four de-alate adults, and on May 23, 1923, one de-alate adult in a cavity in the dead branch of a coffee tree at Indiera.

Despite the common occurrence of nests on live trees, the "comejéns" do not attack any living portion of the tree. Tracing their tunnels to the end, one invariably finds a dead branch or dead wood. While the termites

remain exclusively within their nest and tunnels during the daytime, at night they make sorties by means of which they locate a fresh supply of food, and construct a covered tunnel to it before the sun discovers them. They are remarkably persistent in continuing to repair a broken tunnel when it leads to food, but a piece of wood inserted in the nest is walled off and ignored. While flamboyán trees seem to be preferred on which to construct nests and tunnels, the species of trees infested approximate all those occurring in coastal Puerto Rico, including even mahogany. When com-



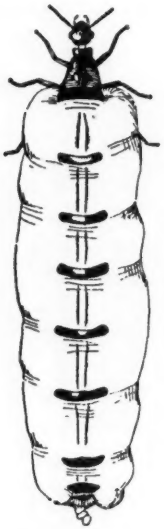
Nymph of *Nasutitermes* (*N.*) *costalis* Holmgren. Ten times natural size. (Drawn by G. N. Wolcott.)



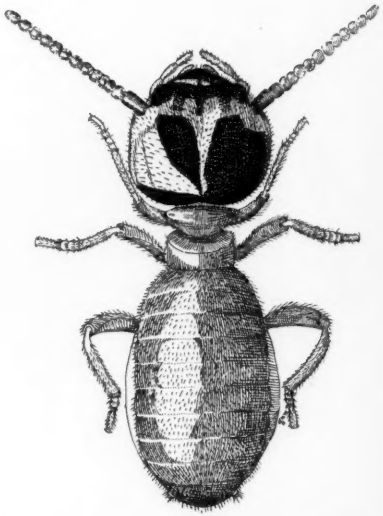
Soldier of *Nasutitermes* (*N.*) *costalis* Holmgren. Twenty times natural size. (Drawn by G. N. Wolcott.)

mencing his work towards a doctorate thesis, Dr. Luis F. Martorell (Caribbean Forester, **2** (2): 80–82. New Orleans, January 1941) observed 84 species of trees attacked. Every kind of dead wood is attacked, including even swamp-cured mangrove (or úcar), an arbor of this in the Station grounds at Río Piedras showing how both arbor and supporting vines are eaten. A manufacturer of concrete arbors imitating rustic wood, to increase their similitude, included a comejenera of concrete. The "comején" is a really serious pest in cut-over mangrove swamps, where so much of the decaying stumps are eaten that new shoots have difficulty in getting started. Attempts to drown out the termites by cutting stumps so low that they will be covered at high tide have not been notably successful, the

use of finely powdered Paris green (a table spoonfull in the top of the broken-open nest), elsewhere so successful in control if used during dry weather, failing because the moistened powder cakes and does not adhere to the bodies of the termites. Breaking open a comejenera, or any of the tunnels of carton from it, one first sees the clumsy, big-headed nymphs retreating before the light of day, and then, promptly coming up to defend the colony, the much smaller soldiers with their dark brown heads with elongated beak or "nasutum" in front. From this is ejected a sticky, stink-



Ovipositing queen of *Nasutitermes* (*N.*) *costalis* Holmgren, four times natural size. (Drawn by G. N. Wolcott.)



Worker of *Nasutitermes* (*N.*) *costalis* Holmgren, about twelve times natural size. (Drawn by G. N. Wolcott.)

ing fluid that is sufficiently unpleasant on your hands, and is entirely effective in gumming up and driving away such smaller enemies of the termites as ants. Thousands of these soldiers are soon mobilized at the point where nest or tunnels have been broken open, and they run wildly about outside in search of the cause of the disturbance. If nothing more happens, they gradually concentrate where the break occurred, and guard the nymphs coming up to make repairs. The fat, transparent abdomens of the nymphs, distended with partly digested food and excrement plainly visible, provide the building material with which the thin wall of the nest or tunnel is

quickly extended, so that in surprisingly short time the roof is again complete. One sees only a multitude of soldiers standing guard, and the head and then the rear end of one of a steady procession of nymphs coming up to make its contribution to the wall of excrement, which dries to form carton. Actually, the nymphs are much more numerous than the soldiers, and in a large nest must number millions, all brothers and sisters, with (normally) but a single male and female parent. The male is no larger than when he started the colony with his mate, and is lost in the immensity of the number of his progeny. The queen, mother of millions, has developed an enormously distended abdomen almost as large as the last two joints of your little finger. She lives walled in by thickened carton in a spacious chamber low down towards the center of the nest, continually surrounded by large numbers of her sons and daughters engaged in massaging the royal maternal hide, and carrying away the eggs that emerge in a steady stream from her rear. Her only function is to eat copiously the food supplied her that there may be no slackening in egg production, as the worker nymphs promptly assume all care of the eggs and the nymphs hatching from them. Stored in adjoining chambers until the eggs hatch, the baby nymphs are fed and cared for by their nurses until they attain sufficient size to undertake their share of the duties of the workers in the colony.

The nasuti soldiers are always soldiers to the end of their existence, and very brave and fearless they prove to be in any ordinary crisis. Most of the nymphs, also, retain permanently their workers status, but some of them, possibly because they have been fed a different food, eventually develop wing-pads, and at the next moult the fully-expanded wings of adults. At first these are waxy white, but before the adults are ready to emerge from the nest, their wings have become blue-black and their bodies are brown and tough.

The adults of what Prof. Nathan Banks described as **Nasutitermes creolina** from Trinidad, St. Thomas, Vieques and Puerto Rico, are more yellowish, smaller and with smaller eyes. The soldiers are reddish-brown, with a shorter nasutum, and "hairy all over". A comejenera of this species on an "algarrobo" (*Hymenaea courbaril*) in the margin of a coffee grove near Río Piedras was light brown in color, the outside layers being of a uniform brittle character, but the interior layers very hard and tough, containing many hard balls about an inch in diameter, with two or more narrow tunnels leading to the interior. The exterior tunnel to the ground was nearly an inch broad. Only workers, nasuti and immature stages were found, July 8, 1921; the workers bit viciously.

Considering the specific name given by Holmgren to his *Nasutitermes costaricensis*, it seems doubtful that this species occurs in Puerto Rico.

The absence of soldiers or adults in colonies of a species of **Anoplotermes** found living in the earth around roots of a Bougainvillea vine on the Seín farm, Pueblo Viejo in September 1933, made specific determination impossible. "The colonies contained large numbers of very pale minims, some partly grown nymphs, others larger, with abdomens largely filled with earth particles, the largest individuals with yellowish wing-pads having very heavy, elongate abdomens, easily crushed, with a very tender, thin, transparent skin, containing root tissues in the process of digestion", according to Mr. Francisco Seín, who discovered them.

EMBIDIINA

In "A Revision of the Embioptera, or Web-Spinners, of the New World" (Proc. U. S. Nat. Mus., **94** (3175): 401–504, pl. 2. Washington, D. C., 1944), Edward S. Ross records three endemic species of Embiids from Cuba, two from Hispaniola, one from St. Croix and four from Trinidad. The only species to date collected in Puerto Rico is **Oligotoma saundersii** (Westwood), noted by Dr. Gundlach and Kolbe as *O. cubana* Hagen, and listed more recently as *O. latreillei* (Rambur), all names referring to a single species originally described from India. It is, according to Dr. Ross, "artificially tropicopolitan; in the New World, widespread from Texas, Florida, West Indies and México to temperate South America, found especially near cities and towns". Even on nights when no other insects are attracted to lights at Río Piedras, sometimes a single adult will appear. Dr. Gundlach gives no localities of collection, but presumably his specimens were from Mayagüez, where recent collections have been made (Ramos), or at Bayamón, and the species was doubtless widely distributed on the Island even at the time he was here. In addition to the adults attracted to lights, a small colony was found by Prof. J. A. Ramos in a hollowed stem of "escambrón" (*Randia mitis*) at Guanajibo Beach, Mayagüez, December 1944. Careful search on orchids or bromeliads from El Yunque might yield one or more endemic species to match those from the other West Indies.

CORRODENTIA

The cosmopolitan cereal Psocid or "booklouse", **Liposcelis divinatorius** (Müller), a small, wingless, active, light or dark brown insect not more than a millimeter in length, may at times become very common in favorable environments. Dr. Stuart T. Danforth found them a serious pest in imperfectly preserved bird-skins. They have been repeatedly identified by Prof. Nathan Banks from colonies of dry-wood termites left uncared-for in petri dishes, where they jostle the living termites and feed on the dead ones, leaving a fine powdery brown excrement. They can

hardly be considered beneficially symbiotic, for the termites tend to die with increasing rapidity when the Psocids become established in these artificial colonies. They have not been observed in normal "polilla" colonies in wood, but in articles of furniture so nearly destroyed by termites that little remains for them to devour, the Psocids and silverfish can hardly be kept out. This Psocid has been recorded in Puerto Rico attacking dried stored cacao beans, but it presumably occurs on many other stored food products, especially those allowed to remain too long undisturbed in dark warehouses.

What Prof. Nathan Banks described under the name of *Pseudocaecilius wolcotti* (Mus. Comp. Zool. Bull., **65** (12): 423. Cambridge, 1924), collected in Puerto Rico from the underside of palm fronds and bucare leaves, is considered by Dr. Paul J. Chapman, after a study of the paratypes, ("Corrodentia of the United States of America", Jour. N. Y. Ent. Soc., **38** (3 & 4): 219–403, pl. 9. New York, 1930) to be the widely-distributed **Pseudocaecilius pretiosus** Banks, common on citrus trees in Florida, and collected in Texas, and in greenhouses in Washington, D. C. When Dr. Luis F. Martorell was making an intensive study of the insects of forest trees, he collected Psocids from the underside of the leaves of numerous kinds of trees, but all proved to be inhabited by this single species. It makes silken nets or tents, under which may be found both nymphs and adults, their bodies a dull light yellow, their eyes chestnut-brown, the wings of the adults spotted with black. One may presume that they are scavengers on the remains of other insects, for a few and sometimes many mealybugs or scale insects also often occur under the same shelter, but hardly in sufficient abundance to feed many Psocids. They have been noted on El Yunque, and on the beach at Mameyes, and at Salinas, Yauco and Guánica, apparently thriving under all climatic conditions present in Puerto Rico.

Caecilius olitorius, described by Prof. Nathan Banks (Mem. Soc. Cubana Hist. Nat., **15** (4): 385–402, pl. 2. Habana, December 1941, see p. 389) from two yellow and brown specimens collected by Dr. P. J. Darlington on El Yunque, is known only from the types.

Ectopsocus pumilis (Banks) was identified by Dr. A. B. Gurney as the Psocid which Dr. Donald De Leon found under the leaves of "cacao motillo" (*Sloanea berteriana*) at Guavate Camp, Cayey. **Ectopsocus ribagai** Enderlein was found in the decayed flower stalk of a banana at Bayamón. The Psocids infesting the casein-wash walls of the School of Tropical Medicine, collected by Dr. W. A. Hoffman, proved to be a species of **Ectopsocus.**

Embidipsocus lutens Hagen has been found in cereal.

Lachesilla pedicularia (L.) has been found among the seeds and dried leaves of lettuce.

Even the largest nest or tent on the underside of leaves constructed by *Pseudocaecilius pretiosus* is insignificant by comparison with some that are at times noted covering the trunks of large trees from the ground up to where the main limbs branch out. In one examined in Guajataca Gorge, no live insect was present towards the base of the tree, all rapidly retreating to the upper trunk, where they could not be reached. It is possible that this species is represented among those intercepted by the Federal Plant Quarantine inspectors while scouting for fruitflies in grapefruit groves: **Polypsocus fasciatus** Banks at Bayamón and at Manatí, **Archipsocus brazilianus** Enderlein at Garrochales, and others to which Mr. A. N. Caudell did not assign specific names; **Deipnopsocus** at Arecibo, **Epipsocus** at Bayamón, **Nepticulomima** and **Psoquilla** near **termitorum** Townsend at Palo Seco.

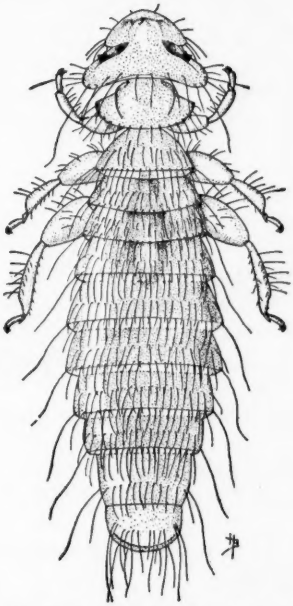
MALLOPHAGA

Most species of the biting bird lice are of cosmopolitan distribution, and occur wherever their specific or similar hosts are to be found. The kangaroo louse, **Heterodoxus longitarsus** Piaget (Boopidae), of which the original host is the kangaroo, also occurs on dogs in as widely separated localities as South Africa, California, and Puerto Rico. It was first collected here by Dr. W. A. Hoffman, and to his industry, and that of Dr. H. L. Van Volkenberg, are due most of the records of bird lice on domestic animals. Guinea pigs in captivity are host of both **Gyropus ovalis** Nitzsch and **Gliricola porcelli** L. (Gyropidae). The common hen louse, **Menopon gallinae** L., and the large body poultry louse, **Eomenacanthus stramineus** Nitzsch, (Menoponidae), are common on chickens and turkeys in Puerto Rico, and on guinea fowl Dr. Hoffman found **Menopon numidiae** Giebel.

Wild birds are hosts for a much greater number of kinds of lice, and local records depend entirely upon the collecting of Dr. Stuart T. Danforth and determinations by Dr. H. E. Ewing. Shore birds are host to undetermined species of **Menopon, Actornithophilus** and **Heleonomus. Menacanthus chrysophaeum** Kellogg and **Myrsidea incerta** Kellogg infest the kingbird, besides four other species of bird lice. **Colpocephalum flavescens** Nitzsch, elsewhere found on eagles, in Puerto Rico lives on the antillean sparrow hawk, and the pearly-eyed thrasher. The "rabijunco" or frigate bird, *Fregata magnificens*, is host to **Amyrsidea aurifasciatum** Kellogg, collected on Mona Island by Dr. Luis F. Martorell in August 1939, as identified by Dr. Ewing. Undetermined species of **Colpocephalum, Myrcidea** occur on various song birds. **Ricinus invadens** Kellogg (Ricinidae) infests warblers and reinitas, and an undetermined **Ricinus,** larger song birds.

The biting goat louse, **Trichodectes (Bovicola) caprae** Gurlt, (Tricho-

dectidae), has been found on goats and cattle, and **Trichodectes (Felicicola) subrostrata** Nitzsch on cats. The lesser chicken louse, **Goniocotes hologaster** Nitzsch (Philopteridae) and **Goniodes dissimilis** Nitzsch also occur on chickens in Puerto Rico, and **Goniodes meleagridis** L. on turkeys. Turkeys are also host for **Lipeurus gallipavonis** Geoffroy, chickens for **Lipeurus caponis** L., guinea hens for **Lipeurus numidiae** Denny, and on the pearly-eyed thrasher an undetermined **Lipeurus. Philopterus quiscali** Osborn infests grackles, and **Philopterus subflavescens** Geoffrey was col-



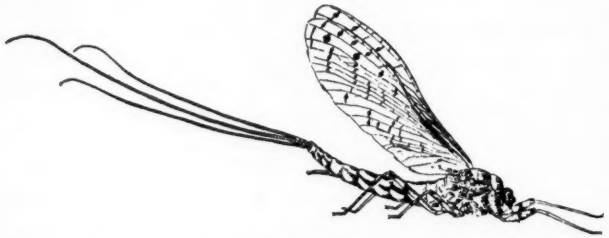
Male of *Eomenacanthus stramineus* Nitzsch. Greatly enlarged. (After Bishopp.)

lected from doves, mockingbirds and thrashers by Dr. Danforth. Grackles are also infested by **Degeeriella illustris** Kellogg, the mockingbird by **Degeeriella eustigma** Kellogg, a sandpiper by **Degeeriella complexiva** Kellogg & Chapman, while undetermined species of this genus were found on kingbirds and on various shore birds. The frigate bird is host to **Esthiopterum gracilicornis major** Kellogg, and other species of **Esthiopterum** were found on grackles, blackbirds and the kingbird. The kingbird is also host to a **Physconelloides** and a **Columbicola,** as are also doves, hawks, and warblers to other species of these genera.

EPHEMERIDA

Everything that is known about the "Mayflies of Puerto Rico" is in the paper by Dr. Jay R. Traver (Jour. Agr. Univ. P. R., **22** (1): 5–42, pl. 3, ref. 23. Río Piedras, April 15, 1938), based on the collections made by Dr. Julio García-Díaz and Prof. James G. Needham. Only a single species, **Callibaetis completa** Banks, described from Cuba, occurs elsewhere. Nine new species, mostly from El Yunque and the Luquillo Mountains, are described, and seven others, represented only by nymphs, are indicated as being present here. The list is as follows:

Neohagenulus julio Traver 38-9: TYPE from Adjuntas, P. R.
Neohagenulus tinctus Traver 38-12: TYPE from Luquillo Mts., P. R.
Neohagenulus luteolus Traver 38-13: TYPE from Luquillo Mts., P. R.
Neohagenulus spp. No. 1 & No. 2 Traver 38-16: nymphs.



A Mayfly from Hispaniola, five times natural size. (Drawn by F. Maximilien).

Borinquena carmencita Traver 38-18: TYPE from El Yunque, P. R.
Borinquena contradicens Traver 38-20: TYPE from La Mina, El Yunque, P. R.
Caenis spp. No. 1 & No. 2 Traver 38-22: nymphs.
Callibaetis completa Banks?
Traver 38-24: collected by F. Seín at Río Piedras.
Callibaetis sp. Traver 38-25: nymphs, possibly *C. completa*.
Baëtis garcianus Traver 38-26: TYPE from Río Tanamá, P. R.
Baëtis spp. No. 1 & No. 2 Traver 38-28, 29: nymphs.
Cloëodes maculipes Traver 38-33: TYPE from Luquillo Mts., P. R.
Cloëodes portoricensis Traver 38-36: TYPE from Lares, P. R.
Cloëodes consignatus Traver 38-37: TYPE from Río Yúnez, P. R.

ODONATA

A few of the more common dragon flies were collected by Drs. Gundlach and Stahl, and named for them by Herr Hermann Julius Kolbe, being listed by him in "Die geographische verbreitung der Neuroptera und Pseudoneu-

roptera der Antillen, nebst einer ubersicht über die von Herrn Consul Krug auf Portorico gesammelten Arten" (Archiv. für Naturgeschichte, 46th year, **1** (2): 153–178, pl. 13, fig. 11. 1888). Dr. Root in his notes on blood-sucking flies records the capture of a deerfly, *Chrysops costatus* F. by *Lepthemis vesiculosa* F. at Aguirre, but the first intensive study of them dates from the paper, "Odonata or Dragon Flies", by Mrs. Elsie Broughton Klotz in the Scientific Survey of Puerto Rico and the Virgin Islands, **14** (1): 1–107, ref. 95, published by the New York Academy of Sciences in 1932. In "An Ecological Survey of the Fresh Water Insects of Puerto Rico, I. The Odonata: with new Life-Histories" (Jour. Agr. Univ. P. R., **22** (1): 43–97, pl. 8, ref. 44. Río Piedras, April 15, 1938) Dr. Julio García-Díaz presents the results of the rearings, collecting field trips and systematic observations made with Dr. James G. Needham. These cover only Puerto Rico proper, but Dr. Needham has identified three dragonflies collected since on Mona Island by Luis F. Martorell as *Orthemis ferruginea* (F.), *Erythrodiplax umbrata* (L.) and *Enallagma civile* Hagen.

Aeschinidae

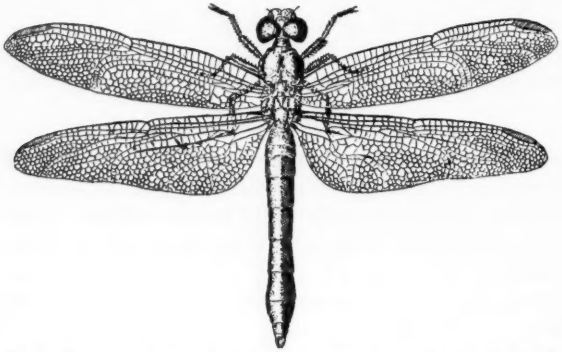
Anax junius (Drury) is a very large, cosmopolitan dragonfly, common in Asia, the Hawaiian Islands, the United States, and definitely recorded from all of the Greater Antilles and some of the Lesser Antilles. It may be recognized by the yellow face, green head, hairy green thorax, basal segments of the abdomen swollen, the first green, the second part green and part blue, the remaining segments brown. The wings are hyaline, often tinged with amber, in the females more densely amber. Mrs. Klotz (1932–16) records collection of adults in Puerto Rico at Aibonito and Adjuntas, and by Don Julio García-Díaz, when a student, on the night trains between Río Piedras and Mayagüez. Prof. James G. Needham noted that the nymphs are "notoriously cannibalistic", which Don Julio thinks (1938–56) as "possibly accounting for the very few reaching adult stage. Although not very often seen, the adult is to be found throughout the entire year and from sea level up to 2,000 feet. Most easily caught when copulating because when doing so the pair usually rests along the shore of the pond." He records numerous collections of adults: from La Muda to Cabo Rojo, and of nymphs from Tortuguero and Cartagena Lagoons. "In the Yúnez River in the gorge above the bridge on Km. 19.6, I have seen the big *Anax*, together with some swallows, early in the morning, flying up and down the river and feeding on the adult mayflies dancing in the air about 30 to 40 feet above."

Anax amazili (Burmeister) has not been found as an adult in Puerto Rico, the record of occurrence being based on two nymphs collected by Don Julio in Hato Rey at Stop 30, in a pool of clear water, not over three

feet deep, temporary even at that time, and since eliminated by construction.

Aeschna (or *Aeshna*) **cornigera** (Brauer) has been found as an adult in Puerto Rico but once, at Adjuntas, but nymphs found by Prof. James G. Needham at Camp Buena Vista, Maricao Forest, at an elevation of 2,350 feet, may be this species.

Coryphaeschna adnexa (Hagen), described from Cuba and ranging from Mexico to Brasil, is comparatively rare as an adult in Puerto Rico, but the white-eyed nymphs were found in abundance by Don Julio (1938–57), quite as common as those of *Anax*, "on the west end of Lake Tortuguero among *Polygonum* plants in standing water about two and a half feet deep".



Adult of *Orthemis ferruginea* (Fabricius), natural size. (Drawn by Fritz Maximilien.)

Acanthagyna nervosa Rambur adults were collected by Don Julio (1938–85) in the completely dry west end of Tortuguero Lagoon, late in the afternoon of October 31, 1937, flying close to the ground among clumps of grasses. As a *Gynacantha*, Kolbe (1888–168) had identified adults collected by Dr. Gundlach and listed by him from Puerto Rico.

Gynacantha trifida Rambur records for Puerto Rico are based on collections by Drs. Stahl and Gundlach, identifications made by Herr Kolbe.

Libellulidae

Orthemis ferruginea (Fabricius), listed from Puerto Rico as *Orthemis discolor* Burmeister by Drs. Stahl and Gundlach, as identified by Herr H. J. Kolbe, is a common, bright red dragon fly with brown veins and stigma on hyaline wings. Despite an extended distribution in the southern United States from Florida to Arizona, and south to Chile, and in prac-

tically all of the West Indies, including Mona Island, no collection has been made in Puerto Rico west of Isabela on the north coast, or west of Juana Díaz on the south coast, despite numerous records in eastern Puerto Rico.

Perithemis domitia (Drury), first reported from Puerto Rico by Drs. Gundlach and Stahl as *Libellula metalla* Selys, is rarely seen as adult, "due to their sensitiveness", according to Don Julio (1938–63) "to bright, shiny, or cloudy damp days". Described from Jamaica, the species seems restricted to the Caribbean area and México. Females have not been found in Puerto Rico, altho Don Julio reared many, in proportion to males, from nymphs taken from a sink-hole pool at Isabela. Males were collected in the field by Prof. Needham at Río Piedras and at Cabo Rojo.

Miathyria marcella Selys, originally described from Cuba, has been found in Puerto Rico only in the northern coastal plain of the Island, according to Don Julio (1938–62).

Micrathyria aequalis Hagen, as identified by Prof. James G. Needham, was collected by him and Don Julio along an irrigation ditch north of Cabo Rojo. Prof. Needham found this dragon fly very abundant at Soledad, Cuba, in May, 1937, where "it swarmed about the edges of the big pond in the botanical garden and in two lesser ponds outside the garden", as reported in "Life History Notes on *Micrathyria* (Odonata)" (Annals Ent. Soc. America, **36** (2): 185–189, fig. 1. Columbus, June 1943). He observed oviposition, and estimated 2000 eggs were laid at one time, from which a reared nymph was described.

Micrathyria didyma didyma (Selys) has not been found in Puerto Rico since collection by Dr. Gundlach, reported as *Dythemis dicrota* Hagen, as identified by Herr H. J. Kolbe, and thus listed (1888–168) by him.

Micrathyria dissocians, described by Prof. Philip P. Calvert ("Odonata" in Biologia Centrali-Americana. Neuroptera, pp. 17–420, pl. 9. London, 1901–8., see pp. 222–6), the type from Mayagüez, P. R. and Vera Cruz, México, is "apparently confined to the coastal plain" according to Don Julio (1938–63), collections having been made at Río Piedras, Vega Baja, Manatí, Caño Tiburones and from Cartagena Lagoon.

Micrathyria hageni Kirby is reported from Puerto Rico by Kolbe, according to Mrs. Klotz (1932–41). Prof. Needham (1943–185) found the nymphs in abundance in Santo Domingo, from which he prepared an illustrated description.

Erythrodiplax umbrata (Linnaeus), a very common, cosmopolitan dragonfly, with a range from the southern United States to the Argentine, was first reported from Puerto Rico as a *Libellula* by Kolbe (1888–167) from material collected by Drs. Gundlach and Stahl, and subsequently by Prof. Calvert and Mrs. Klotz. In addition to material collected by Dr. Luis F. Martorell on Mona Island, identified by Prof. Needham, Dr. D. J.

Borror in "A Revision of the Libelluline Genus *Erythrodiplax* (Odonata)" (pp. 286, pl. 41. Columbus, 1942), also lists it from Vieques Island.

Erythrodiplax connata connata (Burmeister) is thought by Dr. Borror (1942–173) to be the correct name for what Kolbe (1888–169) described as *Diplax portoricana* from the material collected by Dr. Gundlach, and what Mrs. Klotz (1932–45) called *Erythrodiplax miniscula* (Rambur). Don Julio (1939–60) collected it only from the Cartagena Lagoon, and notes that it is not common.

Erythrodiplax naeva (Hagen) is the name given by Dr. Borror (1942–93) for what Mrs. Klotz (1932–46) records as *E. bernice naeva* (Hagen), based on adults from San Juan and Santurce.

Erythrodiplax justiniana Selys is what Dr. Borror (1942–155) thinks is what Herr Kolbe (1888–168) reports as *Diplax ambusta* Hagen, collected by Dr. Gundlach, and of which Mrs. Klotz records numerous collections under the name *E. connata justiniana* Selys. Don Julio (1938–59) found adults "most abundant in swampy places usually with a lot of vegetation, but they occur also along the rivers. They are fast fliers and their direction of flight is erratic. They fly low and seldom stand on the higher plants, preferring the lower ones, usually selecting new perching places every time. Once having located a place where they occur, one is sure to get a good series since they keep close to the place even if many times disturbed". Adults have been found in all parts of Puerto Rico, in the mountains as well as along the coastal plan, but most often at elevations for 1,000 to 2,000 feet.

Brachymesia furcata Hagen, as determined by Prof. James G. Needham, was collected by him, April 5, 1930, near the reservoir at Coamo Springs.

Cannacria herbida (Gundlach), listed as a *Brachymesia* by Mrs. Klotz (1932–51) from the north coast of Puerto Rico, was found by Don Julio (1938–58) "to be restricted to the coastal plain, where adults are quite common throughout the year. Usually they select a stick over the surface of the water where they perch persistently and to which they return after repeated disturbances". Nymphs were found in great abundance close to the shore of Cartagena Lagoon, August 10, 1937.

Erythemis plebeja (Burmeister) was reported by Mrs. Klotz (1932–55) from Ponce and Arecibo. Don Julio (1938–59) has many records, but found it "one of the most difficult dragonflies to obtain because of its alertness and swift flight, and also because it usually chooses open spaces for perching where it is difficult to catch".

Lepthemis vesiculosa (Fabricius) is a large green dragonfly, with unmarked hyaline wings "with the merest touch of yellow at the base of the fore wing", reported by Herr Kolbe (1888–168) from collections made by Dr. Gundlach. It was this dragonfly that Dr. F. M. Root (1922–405) ob-

served capturing a deerfly, *Chrysops variegata* DeGeer, at Aguirre. Don Julio (1938–54) observed that in February and March at Tortuguero Lagoon, these dragonflies "were attacking the small white swamp moths, *Nymphula fluctuosalis* Zeller, which were then very abundant. These moths flew very low over the water surface, among the emergent aquatics, and so were in part protected from *Lepthemis*". It is "one of the most common, if not the commonest, species on the Island. Adults fly tirelessly along the open waters, keeping most of the time close to the shore. They may be exceedingly common, and yet few cast skins may be found. The nymphs live in pools and standing waters, but also in running water, since in 1930 Doctor Needham collected numerous nymphs among algae mats growing in the shallow Coamo River back of Coamo Spring hotel. The highest altitude record is 1,800 feet", according to Don Julio, altho Dr. Richard T. Cotton noted adults abundant in a swampy field near a woods at Aibonito at a somewhat higher elevation. Collected from Las Cabezas to Cabo Rojo in Puerto Rico, and in all the islands of West Indies, this cosmopolitan dragonfly is known from Florida and Texas in the United States, south to Paraguay.

Macrothemis celeno (Selys), identified for Drs. Stahl and Gundlach as *Dythemis pleurostictia* Hagen by Herr Kolbe (1888–168), was originally described from Cuba and has a rather limited distribution in the Greater Antilles and the Virgin Islands. In Puerto Rico it has been extensively collected from sea level to above 2,000 feet, and Don Julio (1938–62) found it "most common and easily seen along the water courses in the high levels. The nymphs in the rivers are found among overhanging roots and stems of plants growing close to the edges. The adults fly along the rivers and usually come to rest on gravel or stones".

Dythemis rufinervis (Burmeister) was identified by Herr Kolbe (1888–168) from collections made by Drs. Stahl and Gundlach: another dragonfly of distribution limited to the Greater Antilles and the Virgin Islands. In Puerto Rico it is found up to elevations of 2,000 feet, the nymphs in mountain rivers as well as in Cartagena and Tortuguero Lagoons. Don Julio (1938–58) notes that "the adults are twig perchers. Once they select a place to stand, they come back to it repeatedly when disturbed and even after being hit by the net. The males are alert, fast flyers and difficult to get when in flight".

Scapanea frontalis (Burmeister), first identified from Puerto Rico by Mr. Rolla P. Currie ("IPSup" 1924–38), is primarily a mountainous species, Don Julio (1938–64) noting that "the nymphs in Puerto Rico, up to the present, have been collected only above the 500 feet level, becoming commoner higher up. The living adult males make themselves conspicuous while in flight by the white spot near the tip of the abdomen segments 7,

8 and 9, and which does not show in many preserved specimens. The females do not show this spot. Both are strong fliers, flitting close to the water, up and down the course of the stream, loitering over pools. They are extremely shy. They copulate without coming to rest. The nymphs prefer rapidly running water, clinging to the stones—some of them to the under surface". Described from Santo Domingo, this dragonfly is known only from the Greater Antilles.

Tramea abdominalis Rambur, identified by Herr Kolbe (1888–167) from material collected by Dr. Gundlach, is a common neotropical dragonfly of coastal Puerto Rico; abdomen red, with mid-dorsal black spot on 8–10, golden brown thorax, head and mouth-parts red or orange-yellow. Don Julio (1938–65) records seeing them "flocking together in large numbers while feeding on the Chironomids which keep in cluster from 12 to 15 or 20 feet above the ground". The nymphs seem scarce by comparison with the abundance of the adults, possibly due to the sinking of clusters of eggs to the bottom where they will be subject to the attacks of fishes and other enemies. Nymphs have been found only at Cartagena Lagoon.

Tramea binotata (Rambur), as determined by Dr. F. Ris, is noted by Mrs. Klotz (1932–70), adults having been collected at Manatí. Prof. Needham and Don Julio made collections at Tortuguero Lagoon, and at near-by localities as far as Arecibo, but the species is decidedly rare.

Tramea onusta (Hagen), as identified by Prof. James G. Needham, is noted by Don Julio (1938–66) as being much more abundant, and often flying with *Tramea abdominalis*, at numerous coastal localities from Las Cabezas and Ceiba to Cartagena Lagoon.

Pantala flavescens (Fabricius), listed by Dr. Gundlach, is not common in Puerto Rico. It "prefers sunny open spaces, where it flies tirelessly", according to Don Julio (1938–63), "keeping usually almost the same level, about five feet from the ground, while getting its food". Prof. Needham and he collected adults at Fajardo, Tortuguero Lagoon and at Yauco.

Idiataphe (= **Ephidatia**) **cubensis** (Hagen), as identified by Prof. James G. Needham, was collected by him only around Tortuguero Lagoon in Puerto Rico, adults being notably scarce when cast skins were numerous. The nymphs are subterranean, hiding among the roots of icaco (*Chrysobalanus icaco*) growing close to the margin, and of sedges and other rooted aquatic vegetation. The nymph was described by Prof. Needham and E. Fisher (Trans. Amer. Ent. Soc., **62**: 107–116, pl. 1. Philadelphia, 1936), not as unique morphologically as in its habits.

Coenagrionidae: Damselflies

Lestes forficula Rambur, first reported from Puerto Rico by Mrs. Klotz (1932–77) from collections along the north coast, at present appears to be the most abundant representative of the genus. Don Julio (1938–70) re-

cords the collection of nymphs at Las Cruces, at an elevation of 1,461 feet, and of cast skins at Cartagena Lagoon. At Tortuguero Lagoon, he noted the very abundant small white swamp moths, *Nymphula fluctuosa* Zeller, in attempting to escape from dragonflies by flying close to the water, were attacked by these and other damselflies occupying the same ecological niche.

Lestes spumarius Selys, identified and reported from Puerto Rico by Herr Kolbe (1888–172) from material collected by Dr. Gundlach, is much less abundant, and Prof. Needham and Don Julio failed to collect specimens. Mrs. Klotz (1932–78) notes a record by Selys, and a single specimen from Arecibo.

Lestes scalaris Gundlach, originally described from Cuba, was reported from Puerto Rico by Prof. P. P. Calvert (1909 and 1919), and collected by Prof. Needham and Don Julio at Florida (Yúnez River) and at Km. 6.7 on the Almirante Road.

Protoneura capillaris (Selys), reported by Baron Edmonde de Selys-Longchamps from Puerto Rico in 1886, has since been collected by Don Julio at Hato Rey: a single specimen, and in numbers at Carolina.

Telebasis dominicanum (Selys), identified as a *Erythragrion* by Herr Kolbe (1888–165) for Dr. Gundlach, and thus listed by them, is one of the common damselflies of the Island. It does not occur at the highest elevations, and Don Julio (1938–71) noted that the adults do not prefer the broad open spaces of the lagoons, but rather small streams bordered with weeds, or the margins of small bodies of water, altho Prof. Needham and he made collections from Guánica Lagoon: adults but no nymphs.

Telebasis vulnerata, described from type material from Puerto Rico, Cuba and Essequibo in Guiana by Hermann A. Hagen in his "Synopsis of the Neuroptera of North America" (*in* Smithsonian Institute Misc. Coll., **4**, 1862 pp. xx & 347. Washington, D. C., 1861), occurs at the higher elevations as well as at sea level, Don Julio noting adults in the Luquillo Mountains "in and above the La Mina Recreation Area, flying in the shade along the courses of small creeks". A nymph collected by Prof. J. G. Needham at Buena Vista Camp in the Maricao Forest, and reared by him to female adult, is described by Don Julio (1938-81) from the cast skin.

Leptobasis vacillans Selys, described from Cuba, is reported by Kolbe (1888–172) and Dr. Gundlach as collected by the latter in Puerto Rico.

Ceratura capreola (Hagen), was reported from Puerto Rico in Hagen's original description (1861–78). Adults keep among the plants and weeds, not flying in the open, according to Don Julio (1938–67), who records collections by Prof. Needham and himself at Tortuguero Lagoon, and in a swampy hollow close to the river at Florida.

Ischnura ramburii (Selys), a cosmopolitan damselfly known to occur from Canada to Paraguay, originally described from Cuba, is characterized by

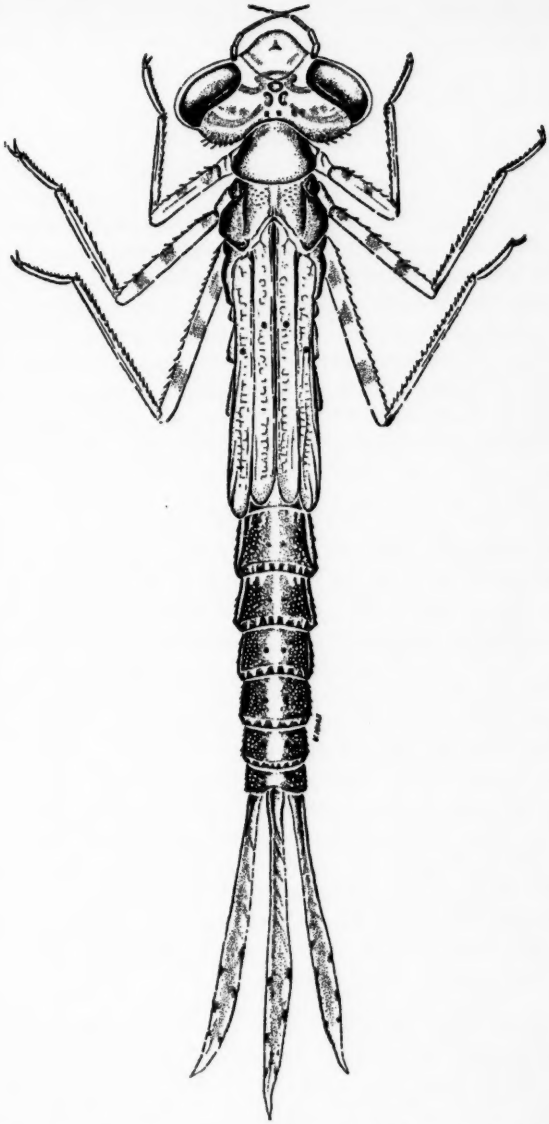
Don Julio (1938–69) as being "the most common damselfly on the Island through the entire year, but apparently restricted to the lower levels. There are no records above the 300 feet line. They become so numerous at times that, failing to find food enough for all, they resort to cannibalism. The pairs in copula fly for long periods together, resting among plants and flying about, but not necessarily ovipositing". Nymphs were found by him in the brackish Caño Tiburones, and with Prof. Needham in Tortuguero, Cartagena and Guánica Lagoons, and in the Río Piedras.

Enallagma civile (Hagen), a northern continental damselfly occurring also in all of the Greater Antilles, was first listed from Puerto Rico by Herr Kolbe (1888–170), identifying material collected by Dr. Gundlach (1894–267). Don Julio (1938–68) notes that "these dainty blue damselflies are found most often flying over pools and standing water. In flight they keep close to the surface of the pool and do not fly for long periods, pausing repeatedly on anything above the water and among the plants along the edge". He and Prof. Needham found adults at both Tortuguero and Cartagena Lagoons, at Río Piedras and at many other coastal localities, but nymphs are very scarce even when adults are most abundant.

Enallagma coecum (Hagen), the type of the typical variety being from St. Thomas and Cuba, was reported from Puerto Rico by Selys, Kolbe and Dr. Gundlach. Mrs. Klotz (1932–96) gives many records of collections from here. Don Julio (1938–68) notes that "nymphs have been collected above 1,000 feet level and the adults above the 2,000 feet line", preferring running to standing waters. In the creek at Florida, the nymphs outnumbered those of *Ischnura* ten to one, and were associated with no other damselfly nymphs.

Enallagma cultellatum (Hagen), as re-identified by Prof. James G. Needham from his original determination of *cardenium* Selys, as listed ("IB" 1936–60) for the first collection at Tortuguero Lagoon, February 10 and 15, 1935, proved to be much less abundant in August according to Don Julio (1938–69). Nymphs have also been found in the brackish water of Caño Tiburones.

Anomalagrion hastatum (Say), a northern continental damselfly, found in all of the Greater Antilles and first reported from Puerto Rico by Prof. P. P. Calvert (1909–210), is "the most inconspicuous of all the zygopterans on the Island", according to Don Julio (1938–66), "and easily overlooked because, although the male has a yellow color, this blends with the dry leaves of the plants in the near-by dry places back of the open waters where they occur. They keep among the plants and weeds, and the females, mostly dull colored, are not easily seen. It seems to be restricted to the lower levels", collections having been made at the Forest Service pool at Río Piedras, Tortuguero and Guánica Lagoons, and other coastal localities.



Nymph of the Damselfly, *Argiallagma minutum* (Selys), twelve times natural size. (Drawn by V. Knox.)

Argiallagma minutum (Selys), as identified by Prof. James G. Needham, was collected by him at Tortuguero Lagoon, February 15, 1935, and on March 9th on the Almirante Road near Vega Baja, with no subsequent collection at any other locality.

NEUROPTERA

Mantispidae: Mantispids

There are no early records of the occurrence of Mantispids in Puerto Rico. Prof. J. A. Ramos found **Mantispa sayi** Banks at Luquillo, August 5, 1932, and **Mantispa brunnea** Say in some abundance at Indiera, in the mountains equidistant from Yauco, Lares and Maricao, July 5, 1944, both species having been determined by Prof. Nathan Banks. The large raptorial forelegs of these insects are their most obvious characteristic, which, when extended, double the apparent length of the insect. Of the latter species, they are brown in color, as are also its short, knobbed antennae, its legs and body being mostly black, marked with yellow, and its wings clear brown.

Hemerobiidae

The local species of Hemerobid brown lacewings are small, inconspicuous insects, with brown, mottled and hairy wings, which are held roof-like over their back when at rest. Most of them have been collected only in the mountains: **Hemerobius jamaicensis** Banks in the Maricao Forest and in the mountains back of Mayagüez in May and June, **Nusalala damiensis** Smith in the Luquillo Mountains at El Verde in June, and **Micromus cubanus** Hagen on El Yunque in May and at Maricao in December. The only exception is of **Micromus haitiensis** Smith, in light traps of the Public Health Service at Camp O'Reilly, near Gurabo, in large numbers in June. This is just the reverse of the ecological conditions under which the types were collected. *Micromus haitiensis*, described by Dr. Roger C. Smith in "The Neuroptera of Haiti, West Indies" (Annals Ent. Soc. America, **24** (4): 798–823, pl. 2, ref. 11. Columbus, December 1931), is from Petionville, in the mountains south of the Cul-de-Sac Plain, and that of the *Nusalala* is presumably at Damien, only a few feet above sea-level.

Dilaridae

Dr. Donald De Leon, on May 1, 1940, collected at light at Doña Juana Camp, Villalba, specimens which were identified by Dr. A. B. Gurney as species of *Dilar*, and thus listed in De Leon's MS "Annotated List of Forest Insects collected in Puerto Rico" (Berkeley, California, February 7, 1941). Dr. Gurney now writes: "According to present conceptions, *Dilar* is restricted to the Old World. In the National Museum there is one specimen

of **Nallachius** from Puerto Rico, and Carpenter (Proc. Amer. Acad. Arts Sci., **74** (7): 273. 1940) reports an undescribed species of **Nallachius** in the M.C.Z. from Puerto Rico. It may be that the species of *Dilar* referred to is the same as this".

Chrysopidae: Aphislions

One of the largest of the aphislions or green lacewings, with two spots on the forewings and one on each of the hindwings is **Leucochrysa insularis** (Walker), identified by Kolbe as a *Protochrysopa* for Dr. Gundlach, and thus listed by him. Presumably it occurs in the mountains back of Mayagüez, but the only recent collections were made in November 1941, at El Verde Forest Service Camp in the Luquillo Mountains, where the insects were attracted to light in considerable numbers, and were collected in the morning from the ceiling, where they had remained overnight. Prof. Nathan Banks places the name *Nodita cerveraei* in synonymy.

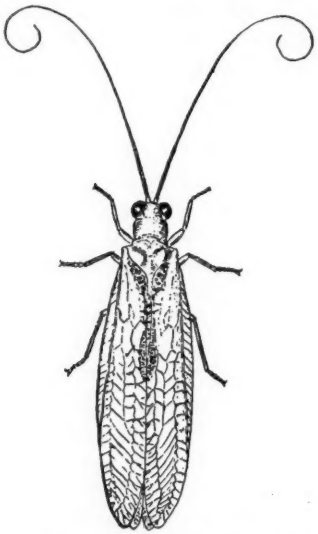
Of the aphislions or green lacewings, numerous species of the genus *Chrysopa* occur in Puerto Rico. Prof. Nathan Banks is of the opinion that of those listed by Dr. Gundlach, *Chrysopa krugii*, described by Herr. H. J. Kolbe from Puerto Rico ("Neuroptera v. d. Sammlung von Herr Krug", Archiv. fur Naturgeschichte, **1** (2): 153–178, p. 13, fig. 11. 1888) "may well be **Chrysopa transversa** Walker", and "*Chrysopa externa* Hagen is a U. S. species; the record probably was **Chrysopa exterior** Navas".

Chrysopa transversa Walker, possibly the most common species on Mona Island, has not recently been collected in Puerto Rico. **Chrysopa damiensis, Chrysopa haitiensis,** and **Chrysopa wolcotti,** all originally described from Haitian material by Dr. Roger C. Smith, have since been found in Puerto Rico, and the first two of these also on Mona. **Chrysopa collaris** Schneider does occur in Puerto Rico, but presumably some of the biologic records assigned to it refer to other species. Prof. Nathan Banks has identified specimens collected in Puerto Rico of **Chrysopa antillana** Navas, **Chrysopa cubana** Hagen, **Chrysopa cubensis** Navas, **Chrysopa estradai** Navas, and **Chrysopa exterior** Navas, making a total of eleven for Puerto Rico and four for Mona Island. Unfortunately, Smith's key to the Haitian species does not include some of these, making identification difficult if one does not have the older literature.

The female lacewing lays individual eggs at the end of tall silken stalks, rarely more than two or three at one time or place, and, to quote Essig, "always a source of wonder to those who discover them for the first time". The minute larva crawls down the stalk holding on by its prehensile tail, and starts off in search for live food. Young aphids are most acceptable and the larvae have been reared to adult by Mr. Thos. H. Jones, feeding them entirely on the yellow aphid of sugar-cane, *Sipha flava* Forbes. They

also eat mealybugs and the nymphs of Fulgorids, *Ormenis* spp. Most surprising of all is the attack of *Chrysopa* larvae on the eggs of the vaquita, *Diaprepes abbreviatus* L., which are laid between two leaves stuck together tightly with a glue so adhesive that the little vaquita grubs themselves have difficulty in escaping from its continuous strip around the egg-mass.

The accidental introduction into Puerto Rico of the cottony cushion scale, *Icerya purchasi* Maskell, for a time supplied an abundant and most acceptable supply of food for the Chrysopid larvae, until the native and introduced enemies of this scale almost exterminated it in Puerto Rico.



An adult *Chrysopa*. Three times natural size. (Drawn by F. Maximilien.)

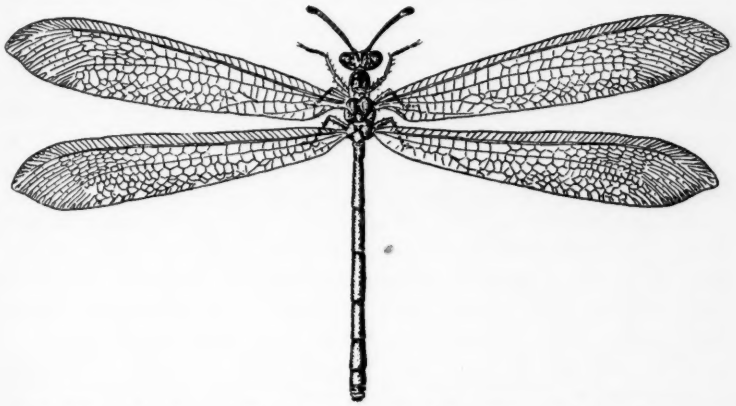
In the grove of beefwood or Australian pines (*Casuarina equisetifolia*) back of Camp Kofresí on Mona Island, however, the cottony cushion scale has managed to survive in much larger numbers, and on infested trees one often sees many of the round, white, parchment-like cocoons spun by the *Chrysopa* larvae which have been feeding on these soft scales.

The most obvious part of the *Chrysopa* larva is its tremendous and deadly jaws: hollow sickles thru which the body juices of its prey are sucked. Many species have the habit of attaching to their bodies, not the scalps of their victims, but its insect equivalent: anything in the way of empty skin or wax that is left after the luckless insect has been sucked dry. And anything still remaining of insect or other debris when the fully grown larva

starts to spin its cocoon may be entangled in its outer threads. Other larvae are completely naked, one noted at Indiera being brightly marked with chrome yellow on a black and brown body, and their cocoons are pearly white spheres, entirely devoid of camouflage. The adults are a symphony in green and gold, with extremely elongate antennae and the most iridescent of transparent wings.

Myrmeleonidae: Antlions

The antlions, with their short, clubbed antennae, and narrow grey wings, often an inch or more in length, are represented on Mona Island by the common **Psammoleon bistichus** (Hagen), dozens of which Dr. L. F. Martorell collected at light at Camp Kofresí in August. **Psammoleon minora**



Adult of *Myrmeleon insertus* Hagen. Twice natural size. (Drawn by F. Maximilien.)

Banks has been collected by Prof. J. A. Ramos both at Mayagüez and on Mona Island, and on Mona he also found **Myrmeleon insertus** Hagen. This latter is the common species in Puerto Rico, listed by Kolbe and Drs. Stahl and Gundlach, of which larvae are often noted in numbers in dry or sandy soil in all parts of the Island. Abundant as their inverted cones may be in soil under houses or under eaves, the adults rarely come to lights.

As an *Acanthaclisis*, Dr. Gundlach records the collection in Puerto Rico of **Vella fallax** (Rambur), and of its occurrence elsewhere, in México and South America. It has not since been found here.

Ascalaphidae: Ascalaphids

The Ascalaphids are possibly the largest of the Neuroptera, with long antennae, knobbed at the end. The **Ascalaphus hyalinus** Latreille, listed

by Dr. Gundlach, has not since been collected in Puerto Rico. The distinctively Puerto Rican species is **Ululodes opposita,** described by Prof. Nathan Banks as one of the "Antillean Ascalaphidae" (Jour. Agr., U. P. R., **22** (2): 177–180, pl. 1. San Juan, May 1938), first found at Cabo Rojo lighthouse, and later on Mona Island. Its male has a dark spot on the stigma of the forewing, the female a spot on the hindwing.

TRICHOPTERA: Caddis Flies

In Dr. Boyd B. Palmer's "A Contribution to the Life History of **Chimarrha albomaculata** Kolbe from Puerto Rico (Trichoptera: Philopotamatidae)" (Annals. Ent. Soc. America, **31** (1): 69–73, pl. 2, ref. 6. Columbus, March 1938), the most abundant caddis fly of the smaller coastal streams is discussed. It is endemic in Puerto Rico, having been described by Kolbe (1888-175) from material collected here by Dr. Gundlach, and is not known to occur elsewhere. The adult is a small golden-brown insect, immediately recognized by the eight silvery, hairy spots on its dusky forewings. The very elongate, golden yellow larvae live in streams under submerged rocks where dead leaves have caught, constructing loose nets which collect a fine film of silt and promote the algal growth on which they feed. The cocoon is surrounded by an outer masonry of stones in addition to its tough inner layer of silk. The adults are attracted to light, and have been seen in large numbers at Mameyes in March 1913. During the daytime, they hide in vegetation, having been noted, in December 1940, in the hollow fruit of the jack-in-the-box or "mago" tree (*Hernandia sonora*), locally a common tree in the coastal plain of the Mameyes River.

In the waters of the mountain streams at higher elevations, other caddis fly larvae become more abundant, twelve undescribed species of which have been identified and placed in genus and/or family by Dr. Cornelius Betten from the material collected by Drs. Needham and Julio García-Díaz in their ecological survey of fresh water insects. These include another **Chimarrha,** species of **Heliopsyche** (Sericostomatidae), and **Phylloicus** (Calamoceratidae), another **Setodes** (Leptoceridae) in addition to the **Setodes candida** Hagen collected by Dr. Gundlach and identified for him by Kolbe, a **Smicridea** (Hydropsychidae), a new genus in both the Polycentropidae and the Hydroptilidae, besides species of **Oxyethira, Neotrichia** and **Hydroptila** in the latter family, **Lype** in the Psychomyidae, and, at the end of the list (Appendix A., García-Díaz 1938–96), **Atopsyche** in the Rhyacophilidae.

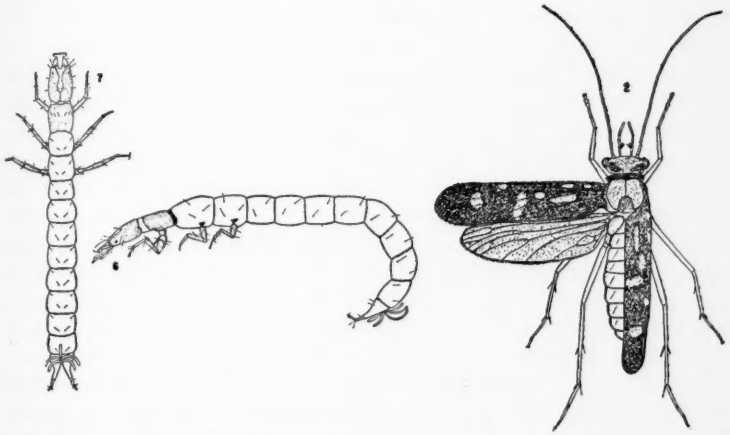
Apparently these collections represent only a fraction of the caddis fly population of the Island, for Dr. D. G. Denning of the University of Wyoming, has described five additional "New Trichoptera from Puerto Rico" (Annals Ent. Soc. America, **40** (4): 656–661, pl. 1. Columbus,

December 1947) from material collected at light trap by Dr. Harry D. Pratt, and identified two others not previously known from Puerto Rico.

Oecetis pratti, described by Dr. D. G. Denning (1947–656) from a single male from El Yunque, is 9.0 mm. long, and has a "long, slender, apically enlarged" tenth tergite.

Oecetis inconspicua (Walker), as identified by Dr. D. G. Denning, was collected in abundance in the vicinity of Laguna Tortuguero.

Chimarra luquillo was described by Dr. D. G. Denning (1947–657) from an abundance of material collected above Luquillo "from roaring streams coming out of the high tropical rain forest" of El Yunque at an approxi-



The common Caddis Fly, *Chimarrha albomaculata* Kolbe: larva from above (7) and from the side (6), about three times natural size, and male adult (2), about five times natural size. (Drawn by Boyd B. Palmer.)

mate elevation of 500 feet. "In both sexes the head, body antennae and legs (are) bright yellow, setae of head and thorax yellow, spurs brownish; the fore wings blackish with a number of bright silver markings".

Chimarra aterrima Hagen was identified by Dr. Denning from a pair collected at Luquillo by Dr. H. D. Pratt in November 1943.

Cheumatopsyche protera was described by Dr. D. G. Denning (1947–658) from a pair collected at light trap at Luquillo, 6.0 mm. long, "wings brownish with a distinct white spot along margin of forewing".

Polycentropus zaneta was described by Dr. D. G. Denning (1947–660) from two pair collected at Luquillo, making no mention of their size or general appearance.

Rhyacophila carula was described by Dr. D. G. Denning (1947–660) from material taken from light trap at Luquillo, both male and female being 9.0 mm. long.

THYSANOPTERA: Thrips

The curled-up, distorted tender young leaves of the "laurel de la India" (*Ficus nitida*), which occur in ever increasing numbers as periods of drought lengthen, are a most obvious symptom of the presence of one kind of thrips, **Gynaikothrips ficorum** Marchal (= *G. uzei* Zimmerman, = *Liothrips bakeri* Crawford), on this one kind of tree. During an exceptionally dry spring, the new growth will be attacked so severely that all of these atrophied leaves drop off, and only old leaves remain on the tree. Because of its normally dense growth of foliage during rainy weather and the ease with which the tree can be grown and trimmed, the "laurel de la India" has been selected for formal planting in the "plaza de recreo" of many a tropical city or town. The most serious objection to its use in such situations is its specific thrips, of which the official common name is the Cuban laurel thrips. The adults are elongate little black insects, which normally do not bite people, but often occur in such numbers as to be very objectionable. Examining one of the freshly distorted leaves, one finds within, on its curled-up upper surface, the much smaller, semi-transparent, yellowish immature stages, which become darker and acquire wings when they mature. Often on a single leaf all stages of the life-history of the insect are displayed, as well as the fragile, white, empty molted skins. Every passing breeze brings down a few of these leaves, but a heavy rain may defoliate the tree of new growth, littering the ground beneath with debris. The eventual effect of rain, however, is to greatly lessen the numbers of thrips, and allow the tree to develop new leaves uninjured by their attack. Normally, the rainfall on El Yunque is ample, but during a dry spring this thrips may become injuriously abundant even there, just as it is practically every year in the plazas of Guayama, Caguas and Manatí, and on the campus of the University of Puerto Rico. The trees recover promptly with the advent of rainy weather, but artificial control is possible at any time. Spraying with one-quarter of one percent of Aldrin (Hyman 118) as a water emulsion will kill all thrips in overnight, but does not prevent eventual re-infestation if unsprayed trees are nearby.

Forty species of thrips are reported as occurring in Puerto Rico, of which twelve have been described from material collected here, and presumably many more occur here, merely awaiting an industrious collector. It need not necessarily be a human collector, for three new endemic species were first found in the stomachs of lizards, when "The Food of Porto Rican Lizards (Jour. Dept. Agr. P. R., 7 (4): 5–37, ref. 8. San Jaun, August 1924) was being studied and these small insects were found entire and un-

harmed, wrapped in a mucilaginous coating in the anterior part of the digestive canal. Mr. A. C. Morgan ("A New Genus, a New Subgenus and Seven New Species of Thysanoptera from Porto Rico", Florida Entomologist, **9** (1): 1–9. Gainesville, 1925) described **Gastrothrips anolis** and **Gastrothrips fuscicauda** from specimens found in the stomachs of *Anolis cristatellus* at Río Piedras, October 3, 1923, and **Lissothrips (Prolissothrips) stratulus** from material taken from *Anolis stratulus* collected by Mr. F. Sein on May 9, 1924 on the lower slopes of El Yunque above Hda. Santa Catalina. The large black adult and the many nymphs with bright red thorax and abdomen, their legs, prothoracic plate and terminal segment black, found in rotten cotton boll injured by pink bollworm at Pt. Cangrejos, and others on the leaves of *Inga vera* at Cayey, Mr. Morgan (1925–7) described under the name **Diceratothrips wolcotti.** Others on leaves of *Inga vera* at Cayey he identified as **Ommatothrips gossypii** Hood.

Identified as a new species of **Cryptothrips** by Prof. J. R. Watson were thrips found on the leaves of seagrape (*Coccoloba uvifera*) at Quebradillas in January 1945, of which the immature forms were bright yellow, and the winged female adults were a very intense yellow except for the black head and the tip of the abdomen. The nymphs remained quietly on the upper surface of the leaves in the hollows between the galls of *Ctenodactylomyia watsoni* Felt, but the adults crawled actively about, often entering the empty gall when an emergence hole made this possible.

The inter-relations of thrips to various other small insects and other thrips are often complicated, for some species are predaceous. In his "Notes on Puerto Rican Thysanoptera" (Jour. Dept. Agr. P. R., **10** (3 & 4): 279–281. Río Piedras, September 1927), Dr. H. L. Dozier records the collection of **Aleurodothrips fascipennis** Franklin "from citrus material infested with soft and purple scale, May 24, 1925, at Río Piedras" without attempting to determine its status. But of **Hoplandothrips reynei** Priesner, he implies that it is predaceous on the pustule scale, claiming to have reared it from *Asterolecanium pustulans* on "cañafístula" (*Cassia fistula*). (According to Mr. J. C. Crawford, it "undoubtedly feeds on decaying vegetation, likely on fungi or the sap therefrom.") **Liophloeothrips portoricensis** Watson MS was associated with citrus mealy-bug and scale on grass at Río Piedras. **Franklinothrips vespiformis** Crawford, definitely known to be predaceous, was found by Dr. Dozier on whitefly-infested foliage of guava (*Psidium guajava*) and by Mr. E. G. Smyth on the leaves of beans and sweet potato infested with various small insects. In lima bean flowers infested with thrips at Isabela, a single specimen identified by Prof. J. R. Watson was noted, and Dr. Dozier reports it in rose flowers.

That **Haplothrips merrilli** Watson, as doubtfully identified by Dr. J. D. Hood, was associated by Dr. Dozier (1927–28) "with either scale or whitefly

material would indicate that the species is most likely predaceous on the young."

Haplothrips gowdeyi Hood, first reported by Dr. J. D. Hood "On a Collection of Thysanoptera from Porto Rico" (Insecutor Inscitiae Menstruus, **1** (12): 149–154. Washington, D. C., December 1913), has subsequently been found on such botanically diverse hosts as "almendra" (*Terminalia catappa*), the weed *Blechum brownei*, and the flowers of "margarita", *Bidens pilosa*. It is sometimes so abundant on the flowers of tuberose as to be of economic importance, and so persistent in remaining on this host and on carnations as to be still present on the withering flowers and intercepted by the Plant Quarantine Inspector at Philadelphia.

Haplothrips tibialis, described by Dr. J. D. Hood as one of "Two Porto Rican Thysanoptera from Sugar Cane", (Insecutor Inscitiae Menstruus, **2** (3): 38–41. Washington, D. C., March 1914) was collected by Mr. Thos. H. Jones at Río Piedras. The adults are black in color, and the species has been subsequently called the black thrips of sugar-cane, despite its scarcity and apparent lack of economic importance. The other, listed first as a *Haplothrips*, and subsequently as a *Heliothrips*, is **Hercinothrips femoralis** (Reuter), altho found only in the central whorl of young ratoon cane in Puerto Rico, is a cosmopolitan species with a wide range of hosts.

When an intensive search was being made for possible vectors of the mosaic disease of sugar-cane, numerous collections of the not very abundant thrips to be found in the central whorls were made. From this material, Mr. A. C. Morgan (1925–4) described as new **Anaphothrips bicolor,** collected from the leaves of sugar-cane at Bayamón, May 25, 1920.

"**Anaphothrips** (**Chaetanaphothrips**) **orchidii** (Moulton), with brown wings, and **Scirtothrips longipennis** Bagnall, a small brown species with forewings black to the tips, have caused more injury to *Chinchona* than any other insects thus far encountered," according to Messrs Harold K. Plank and H. F. Winters reporting on the "Insect and other Animal Pests of Chinchona and their Control in Puerto Rico" (Bulletin No. 46, Federal Experiment Station, Mayagüez, pp. 16, fig. 5, ref. 16. Washington, D. C., February 1949). "Both have occurred in the greenhouse at Mayagüez (elevation 50 feet), as well as in the nurseries at Maricao and Toro Negro," high in the mountains, attacking only small to medium-sized plants. For control, "weekly applications of the one per cent rotenone dust gave the best results and proved to be the most practicable for small plants under all conditions." Two other black species of thrips, **Tryphactothrips angulatus** (Hood) and *Dinurothrips hookeri* Hood were also found on *Chinchona ledgeriana* trees at Toro Negro, as well as the common greenhouse thrips *Heliothrips haemorrhoidalis* (Bouché), first noted on *Chinchona calisaya* Wedd.

Karynothrips melaleneus (Bagnall), listed by Mr. Morgan as *Hindsiana cocois* Watson, was collected on sugar-cane at Camuy, April 26, 1920.

Karynothrips flavipes (Jones), listed as *Hindsiana weigeli* by Mr. Morgan, was collected from sugar-cane at Río Piedras, Feb. 23, 1920.

Limnothrips cerealium Haliday was identified by Mr. Morgan from material collected on the leaves of sugar-cane at Guánica, March 18, 1920.

When Dr. F. M. Wadley reported his "Observations on some Insects associated with Sugarcane in Puerto Rico" (Jour. Agr. U. P. R., **21** (2): 103–114, ref. 15. Río Piedras, July 1937), he listed no thrips from sugar-cane, but **"Chirothrips mexicanus** Crawford was repeatedly noted in heads of *Eleusine indica*", a common grass in cane fields called "yerba dulce".

Podothrips semiflavus was one of "Two New Thysanoptera from Porto Rico" (Insecutor Inscitiae Menstruus, **1** (6): 65–70, pl. 1. Washington, D. C., June 1913) described by Dr. J. D. Hood from material collected at Guánica from "malojillo" (*Panicum barbinode*), growing in cane fields.

This by no means concludes the list of thrips found on or associated with sugar-cane in Puerto Rico. Possibly the most abundant, and certainly the most frequently collected thrips in the central whorl of leaves of cane during times of drought is **Frankliniella williamsi** Hood, of which the adults are yellow. Subsequently called the "yellow thrips of sugar-cane", it was first identified by Mr. A. C. Morgan, and is the only species of this genus not associated with flowers. It can hardly be considered an economic species, for no appreciable damage due to even the heaviest infestations has been noted.

During dry weather, many kinds of thrips are found in flowers. The most common is possibly **Frankliniella insularis** Franklin, which is often a serious pest of roses, dahlias and gardenias, the flowers having so many of these black insects hiding between their petals that young ladies are repelled at the thought of wearing them. Cut flowers are not the only hosts, for this thrips occurs on many other kinds of flowers: those of such crops as beans, lima beans, broccoli, pigeon peas, and of trees, such as grapefruit, citron, "roble" (*Tabebuia pallida*), "cereza" (*Malpighia punicifolia*) and cannon-ball tree (*Couroupita guianensis*). It was first mentioned by Dr. J. D. Hood, reporting "On a Collection of Thysanoptera from Puerto Rico" (Insecutor Inscitiae Menstruus, **1** (12): 149–154. Washington, D. C., December 1913), listed by Van Zwaluwenburg, and found by Dr. Wetmore to have been eaten by the green mango (*Anthracothorax viridis*), which is a bird, not a fruit. Dr. M. D. Leonard reports its occurrence on Vieques Island, on roses and cannas, and on hibiscus flowers at Mayagüez. It also occurs on such plebeian flowers as crotalaria and the little wild daisy or "margarita" (*Bidens pilosa*). Prof. James G. Needham in

Florida, observing that "An Insect Community Lives in Flower Heads" (Nat. Geographic Mag., **90** (3): 340–356, with photographs by Willard R. Culver, 11 in color. Washington, D. C., September 1946) of *Bidens pilosa*, which he calls shepherd's needles, notes that it is "a honey plant of some importance. The flowers are very pretty and give off a delicate fragrance. Honey made from their nectar has something of the same fragrance. This Bidens (meaning 'two-pronged': seeds with two long barbed prongs) is a common roadside and pathside weed in the coastal areas of southern Florida and throughout the West Indies. It is a tender plant that is killed by even a light frost. It is long-lived and vigorous, but it dies back from the top after fruiting, and comes again from below in new branches that appear in all-season succession. Thus it is in flower and in fruit every day in the year . . . thrips . . . are the most constant residents in all Bidens flower heads. They are small enough to enter bodily into the crevices between flowers, or go down into the depths of the corolla tubes and live there, adults and young together. Individually they are so small that the damage to the plant is usually negligible." Prof. Needham gives no names of specific thrips, but in Puerto Rico, in addition to the common flower thrips, *Frankliniella insularis*, two others of the same genus: **Frankliniella melanommata** Williams, the flower thrips of the West Indies, and **F. cubensis** Hood have been found in considerable abundance in the flower heads of this daisy, as well as **Thrips abdominalis** Crawford and **Haplothrips gowdeyi** Hood.

Frankliniella cubensis Hood is possibly only an incidental resident on *Bidens pilosa* flower heads, and in the flowers of hibiscus, crotalaria and citrus, for it has been found in great abundance on the leaves of yuca (*Manihot utilissima*) in June 1933 by Mr. F. Seín, causing a puckering, crinkling and yellowing of the leaves simulating a mosaic disease. Prof. J. R. Watson, who identified the material, notes that a very similar Florida species, "although mostly an inhabitant of blossoms, will sometimes attack other tender vegetation. It causes quite a crinkling of the foliage of peanuts, sometimes, and occasionally of beans and cucumbers".

Corynothrips stenopterus Williams, as determined by Mr. A. C. Morgan, was observed by Mr. E. G. Smyth in 1919 to be causing injury to yuca at Río Piedras.

The record of **Frankliniella tritici** Fitch in Puerto Rico, questioned by Prof. J. R. Watson (1923–39) as being "probably *cephalica*" is confirmed by a subsequent identification by Dr. J. D. Hood of material collected by Dr. H. L. Dozier (1927–280) in flowers of grapefruit at Trujillo Alto. It is by no means the most abundant thrips normally found in the flowers of grapefruit, Dr. M. D. Leonard in his note on "Thrips Injury to Citrus and Rose in Puerto Rico" (Jour. Ec. Ent., **25** (4): 934–5. Geneva, August 1932)

making no mention of it, but only of the black *F. insularis* and the yellow *F. cubensis*, and the collection by Mr. A. S. Mills at Palo Seco and Vega Alta of **F. difficilis** Hood, as determined by Prof. J. R. Watson, from grapefruit blossoms. Subsequently, this species was found on dahlia flowers at Sabana Llana by Mr. Miguel Angel Díaz, and on hibiscus flowers at Ponce by Mr. R. G. Oakley. **Frankliniella citripes** Hood, as identified by Prof. J. P. Watson, has been collected on the flowers of citron (*Citrus medica*) at Las Marías.

The type of **Frankliniella borinquen,** described on p. 675 by Dr. J. D. Hood in his "A Century of New American Thysanoptera III" (Revista Ent., **12** (3): 547–678. Rio de Janeiro, 1942), is from Puerto Rico, collected by Prof. James G. Needham on flowers of *Bidens pilosa*. The type of **Dinurothrips hookeri** Hood (1913–149) was collected by Dr. C. W. Hooker on sweet potato at Mayagüez, and Mr. E. G. Smyth found thrips on this host at Río Piedras which he considered to be this species.

Taeniothrips simplex Morison, the introduced gladiolus thrips, appeared in Puerto Rico soon after gladioli began to be grown here on a large scale, and now appears promptly whenever this host is planted. Injury is negligible during most of the year, but in the spring, and during extended periods of drought may become severe. As there is no dormant season for corms, the treatments used in control of this thrips on corms during the winter can not be used in Puerto Rico. Plants must be watched closely for the first signs of the feeding of the thrips, and spraying started immediately and continued at weekly intervals until flowering. The recommended spray combination, given on Picture Sheet No. 6, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Washington, D. C., April 1941, is as follows:

	Small quantities	Large quantities
Tartar emetic	1 ounce	2 pounds
Brown sugar	2 ounces	4 pounds
Water	3 gallons	100 gallons

Economically, the most important thrips is the cosmopolitan **Thrips tabaci** Lindemann as a pest of onions, which promptly appears on this crop wherever grown. On Mona Island, the initial planting of onions in 1940 was attacked, and all later ones completely destroyed. Planted early enough in the fall so that they approach maturity before the dry weather of late winter and early spring, onions grow well and produce a bountiful crop in Puerto Rico. Planted so late that drought hits them before they are more than well started, infestation by thrips can absolutely ruin the harvest. All thrips are very sensitive to relative humidity, becoming abundant in dry weather, and practically disappearing in wet weather.

This is the key to the successful growing of onions everywhere, but especially in Puerto Rico where the seasonal occurrence of dry weather can be predicted with some accuracy.

The immature stages of the onion thrips are minute and semi-transparent, yellowish, so small and so well hidden under the parchment scales and between the bases of the leaves as to be rather difficult to see. But no one can fail to recognize the wilting and withering of the leaves which is the result of their feeding, becoming more serious as dry weather continues and the thrips become more abundant. If the attack begins when the onions are only half grown, they never can mature, for control depends upon taking advantage of the normally heavy rainfall in the autumn in Puerto Rico, or, failing this, in spraying before injury becomes at all noticeable. The grower who starts spraying only after the withering becomes serious is only wasting his time and energy. In countries where onions are grown under irrigation, and heavy infestations by thrips may be anticipated no matter at what season they are planted, spraying with nicotine sulfate and soap or fish oil is started just as soon as the tender onion leaves appear above ground, and continued without stopping until the onions have almost reached full size. In this way, and only in this way, has it been possible to grow onions successfully where there is little or no rainfall. This is in contrast to the favorable conditions normally present in Puerto Rico, where the growing season may be made to coincide with heavy autumnal rains, and harvesting with the dry weather of winter. At the present time, the nicotine sulfate spray is quite outdated by the tartar emetic and brown sugar spray which was developed for use against the thrips of gladioli, and was soon found to be equally effective against the onion thrips. The most recent development in thrips control is by means of spraying or dusting with DDT, which is equally effective, but not noticeably more effective than tartar emetic, and benzene hexachloride as a dust with 1% gamma isomer content.

The type of **Heterothrips sericatus** Hood (1913–66) was from a great abundance of material found by Mr. Thos. H. Jones in the blossoms of guava (*Psidium guajava*) at Río Piedras, in June 1912. Twenty years and three days later, Mr. A. S. Mills found it very abundant in the blossoms of one bush at Barceloneta. Most recently it was noted on the same host at Palo Seco.

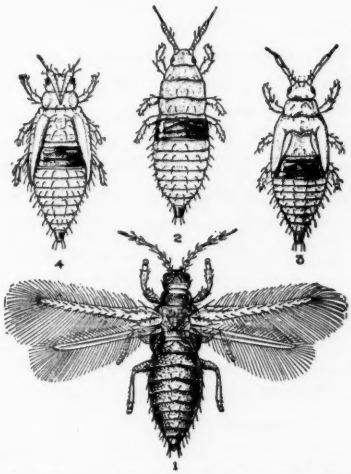
The type of **Heterothrips borinquen,** described by Mr. J. D. Hood (Insecutor Inscitiae Menstruus, **3** (1–4) : 1. Washington, D. C., January–April 1915) was from material collected by Mr. Thos. H. Jones in blossoms of an undetermined plant (Johnston # 2187) between Laguna San José and Martín Peña.

The host of **Cercyothrips striatus** Morgan (1925–1) is similarly uncertain, Mr. E. G. Smyth noting it as a climbing vine at Río Piedras, while **Serico-**

thrips portoricensis Morgan (1925–3) is unaccessioned material collected by him at Río Piedras, March 20, 1920.

In November 1923 the leaves of alfalfa at Río Piedras grown with seed imported from México were noted by Mr. F. Seín as infested with thrips, identified by Mr. A. C. Morgan as *Heliothrips fasciatus* Pergande. This is the common continental bean thrips, now known as **Hercothrips fasciatus** (Pergande), not since found in Puerto Rico, and presumably not established here.

Heliothrips haemorrhoidalis (Bouché), another continental species commonly known as the greenhouse thrips, was collected by Dr. C. W. Hooker at Mayagüez and listed by Dr. Hood (1913–149). Dr. H. L. Dozier



The Red-Banded Thrips, *Selenothrips rubrocinctus* (Giard): adult, larva, pre-pupa and pupa, greatly enlarged. (After Russell.)

(1927–280) found it "abundant, breeding on leaves of an introduced plant, *Barringtonia speciosa*, at Río Piedras, May 24, 1925." It has been identified from grapefruit at Palo Seco, and Mr. E. G. Smyth thought it this species which he observed on orange leaves at La Muda.

Selenothrips rubrocinctus (Giard), the cacao thrips of Trinidad, elsewhere known as the red-banded thrips, is of comparatively little economic importance in Puerto Rico. It is often so common during dry winter weather that its mass feeding causes the leaves of the "almendra" (*Terminalia catappa*) to change their normal green color for a silvery appearance. The adult thrips is black in color, but the larva, pre-pupa and pupa are transparent yellowish except for a broad band of red around the middle of their

bodies, whence the specific name of *rubrocinctus*. The rapidly growing larvae have balanced at their hind end, held high in the air, a sphere of dark brown excrement which is, from time to time, deposited on the leaf. Such dark spots of dried thrips excrement alternate with the silvery areas rasped dry by the feeding of larvae and adults. The leaves of many other common trees, such as mango, jobo, pajuíl, guava, achiote, cenizo and cucubano are more rarely heavily infested, and Dr. Dozier (1927–279) notes injury to those of grapes and cultivated berries. Cacao is so rarely grown in Puerto Rico that it has not even been noted as a host for this thrips, but in Trinidad cacao groves it is a major pest.

A minute wasp parasite, *Dasyscapus parviventris* Gahan, discovered both in Java and on the Gold Coast of Africa, was successfully introduced into Trinidad in an effort at control by natural means, and later was brought to Puerto Rico by Mr. S. M. Dohanian. In Trinidad, he had studied the "Life-History of the Thrips Parasite, *Dasyscapus parviventris* Gahan, and the Technic for Breeding it" (Jour. Ec. Ent., **30** (1): 78–80, ref. 6. Menasha, February 1937), but was there for too short a period to discover the ecological conditions under which it becomes abundant. Unfortunately, the parasite thrives under humid conditions which are least favorable for the thrips, and is consequently never sufficiently abundant during dry weather to exert appreciable effect in control of heavy thrips infestations on cacao or any other host, either in Puerto Rico or in Trinidad.

ANOPLURA: True Lice

The cosmopolitan species of the true lice (Pediculidae) on man: **Pediculus humanus humanus** L. (= *capitas* DeGeer) and **Phthirius pubis** L. occur in Puerto Rico. Dr. H. E. Ewing also identified for Dr. H. L. Van Volkenberg **Haematopinus eurysternus** Nitzsch of which heavy infestations have been noted on the body or eyelids of cattle, and **Haematopinus tuberculatus** Burmeister which is very common in the swtich of the tail of cattle on the south coast. **Haematopinus adventicus** Neumann sometimes becomes abundant on closely confined pigs. **Linognathus africanus** Kellogg & Paine has been found on goats, and Dr. W. A. Hoffman collected **Linognathus piliferus** Burmeister on a dog. From rhesus monkeys in captivity in the cages at the School of Tropical Medicine, Dr. Hoffman collected **Pneumonyssus griffithi** Newstead.

HOMOPTERA

Cicadidae: Cicadas

In "The Cicadas of Porto Rico with a Description of a New Genus and a New Species" (Jour. N. Y. Ent. Soc., **36** (1): 29–34, fig. 2, pl. 1. New York, March 1928), Mr. Wm. T. Davis describes **Borencona aguadilla,** from a type at Indiera, in the mountains north of Yauco, others from Lares, Aibonito and Mayagüez, as being of a "brownish color, pepper and salt appearance—sides of pronotum expanded—medially angulated into sharp points." When alive, this cicada is more greenish-grey in color, admirably matching its coffee grove or tropical forest environment of greenish-grey lichens on the trunks of trees. Altho individuals have been found as far east as Rio Piedras, normally it is an inhabitant of the coffee groves and the higher forests of the western end of the Island. Dr. Wetmore found it eaten by the kingbird and the flycatcher, and presumably the nymphs found around the roots of coffee trees at Añasco were of this species.

Proarna hilaris Germar is the common cicada of Puerto Rico, occurring in all parts of the Island, including the most xerophytic. Dr. Wetmore found it an important factor in the food of b'rds, for presumably it is more readily caught by them than by terestrial entomologists. It has not been found eaten by toads, and apparently is too large to be eaten by lizards. This cicada constituted 4.16% of the food of the ground cuckoo, and 2.47% that of the petchary. It was eaten in smaller numbers by the mangrove cuckoo, the woodpecker, the owl, flycatcher, kingbird, blackbird, oriole, mozambique, the yellow warbler and several vireos. Nymphs have been found in sandy soil being plowed at Mameyes, and at Palo Seco, apparently feeding on the roots of *Wedelia trilobata*, this being practically the only plant present where the nymphs occurred. Altho primarily a coastal species, it also occurs in the mountains, having been collected at Utuado, Coamo and Trujillo Alto.

Cercopidae: Froghoppers

All the froghoppers occurring in Puerto Rico are small, inconspicuous brownish species, much less noticeable than the masses of bubbles, supposedly resembling "frog-spit", which surround the nymphs. The species of **Epicranion**, most often referred to as *championi* Fowler, is usually seen as nymphs inside masses of bubbles around coffee berry clusters, but it is not restricted to a single host for it has also been taken on the twigs of *Inga vera*, and a heavy infestation on twigs of *Ficus stahlii* between Camuy and

the Guajataca Dam in October 1940 included numerous adults. Mr. Francisco Seín, attempting to rear adults, found that most of the whitish nymphs which he collected from coffee at Lares turned black within a few days, being parasitized by an Encyrtid wasp parasite, *Carabunia myersi* Waterson. The maggots of a fly also pester the nymphs inside their liquid covering, and it is hardly surprising that adults are so rarely noted.

The adults of **Philaenus fusco-varius** Stål are minutely pilose, the forewings being marked with two lighter spots and a crescent. They have been noted most often on guava (*Psidium guajava*) but are not confined to a single host, for collections have been made on pomarrosa, mulberry and on both coffee shade trees, and Dr. Stuart T. Danforth had specimens from the Cartagena Lagoon. The nymphs have not been observed.

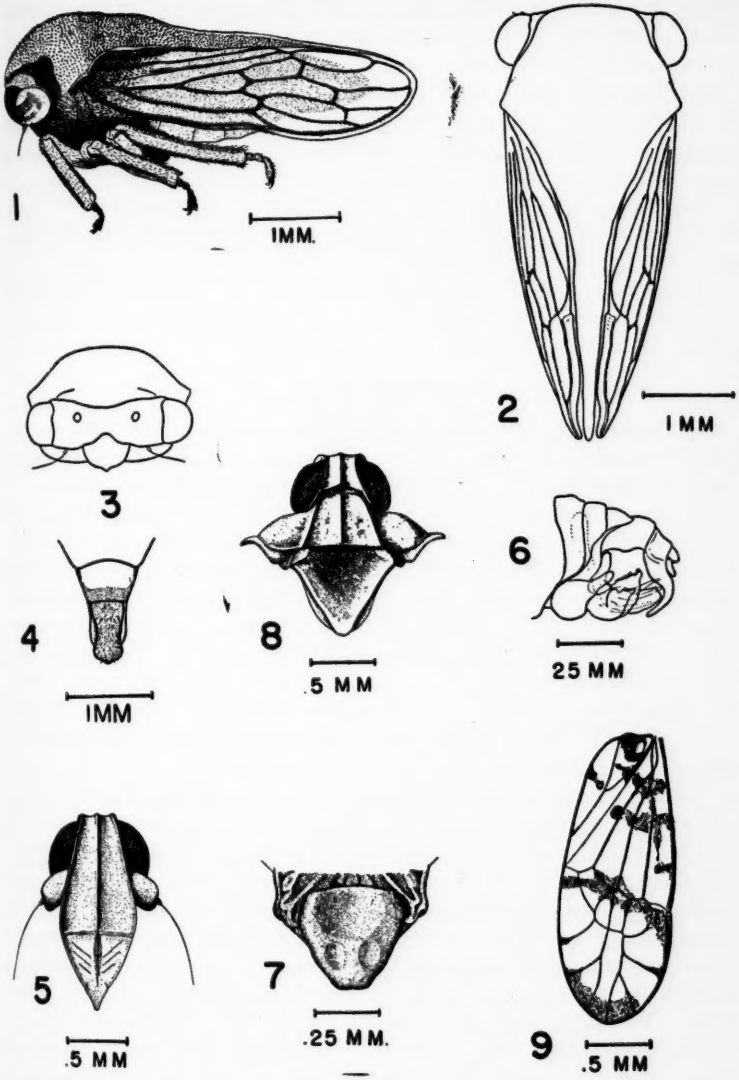
The **Clastoptera brevis** Walker "credited to Porto Rico by Lallemand" according to Dr. Herbert Osborn (1935–128), is "neither *brevis* nor *singifera*" as viewed by Dr. P. W. Oman. It has been intercepted on El Yunque, at Cidra, on coffee at Mayagüez and on mangrove at Ponce.

Membracidae: Treehoppers

Nessorhinus gibberulus Stål, "the most abundant and common species of membracid in Puerto Rico" according to Dr. H. L. Dozier ("New and Interesting West Indian Homoptera", American Museum Novitates No. 510, pp. 24, fig. 18. New York, December 15, 1931), is grey or brown in color, with a smoothly curving pronotum expanding into a snout-like process in front and a much more elongate spotted process behind. The earlier records as *Antianthe expansa* Germar, as identified by Prof. W. D. Funkhouser, refer to this species as found on cotton and coffee, but it shows no clearly defined host preference, having been collected on many and diverse plants and trees from the coast to the most elevated coffee groves.

Nessorhinus vulpes Amyot & Serville has the frontal process of its pronotum curved up, as is shown in the drawing by L. Pierre-Noël, and **Nessorhinus graciloides,** described by Dr. Dozier (1931–3) from a single male from Caguas, a shorter, straight process. Both have an elevated central crest, and neither is abundant, altho Dr. Osborn had specimens of the former from Lares and Mayagüez, and it has been intercepted on pigeon pea at Mayagüez and on icaco at Arecibo.

The broadly rounded and intensely black, shining pronotum produced into a slender spine behind, identifies **Monobelus fasciatus** (F.), a comparatively common species, found in all parts of the Island on a great variety of hosts, showing no apparent preference for any one plant. It is



The Membracid, *Paradarnoides danforthi* Ramos, from Mona Island: 1. Lateral view, 2. Dorsal outline, 3. Frontal view of head, 4. Male genitalia. The Fulgorid (Kinnaridae) *Paraprosotropis monensis* Ramos from Mona Island: 5. Frontal view of head, 6. Lateral view of male genitalia, 7. Ventral view of female subgenital plate, 8. Dorsal view of head and thorax, 9. Tegmen. (Drawn by J. A. Ramos.)

sufficiently numerous to form an appreciable item in the food of the arboreal lizards *Anolis pulchellus* and *Anolis stratulus*, altho there are no records of its being eaten by any bird.

Spinodarnoides typus, described by Dr. W. D. Funkhouser (pp. 413–14) as one of his "New Genera and Species of Neotropical Membracidae", (Jour. N. Y. Ent. Soc., **38** (4): 405–421. New York, December 1930), "near *Paradarnoides*", is known only from the type from Puerto Rico.

Paradarnoides danforthi, described by Prof. J. A. Ramos (1947–15) from collections made on Mona Island is possibly the same as that found by Mr. R. G. Oakley on "roble" at Ponce.

A treehopper tentatively identified by Dr. P. W. Oman as a species of *Micrutalis* was collected by Mr. R. G. Oakley on "pomarrosa" at Aibonito and on "moca" at Juana Díaz.

Cicadellidae: Leafhoppers

The leafhoppers of Puerto Rico are very numerous, but were not intensively studied until the search for a vector of the mosaic disease of sugarcane was being made. Original descriptions and illustrations of many of them were published or quoted by Dr. Herbert Osborn in his "Homoptera excepting the Sternorhynchi" (Scientific Survey of Porto Rico and the Virgin Islands, **14** (2): 111–260, fig. 71, ref. 48. New York, 1935). This follows and greatly expands his earlier "Notes on Porto Rican Homoptera" (Jour. Dept. Agr. P. R., **13** (3): 81–112, ref. 13, map. San Juan, November 1929), which was based on his personal collecting while visiting his son, who worked for several years at Central Aguirre. At the present time, the leafhoppers are again under intensive scrutiny by Mr. José Adsuar, in his efforts to determine the vectors of numerous other mosaic diseases, following up his investigations on those of papaya.

The quaintly marked and sober colored **Agallia albidula** Uhler has been collected, more or less transiently resting, or at times injuriously abundant, on a large number of hosts: string beans, lima beans, cowpeas and "gallito" (*Agati grandiflora*); on wild eggplant, tobacco, tomato, eggplant and potatoes; on watermelon, squash, cucumber and cassava melon; on sugarcane, grasses, asparagus, carrots, cotton and weeds, not only along the coast and on Mona Island, but also high in the mountains. Actually, we know little of its habits, for the nymphs have not been found in Puerto Rico. The earliest record, as *Agallia tenella* Ball, was reported by Mr. O. W. Barret (1904–448), of injurious abundance on beans, cowpeas and other plants. To date, no serious injury to hosts, or transmission of disease, has been proved, despite the numerous instances of temporary abundance of this leafhopper. While intensively searching for the possible vectors of mosaic disease of sugar-cane, and more recently, those of the

bunchy-top disease of papaya, all the species of these short, restless leafhoppers with no well defined host have been intensively collected.

Dr. P. W. Oman in his "Classification of the North American Agallian Leaf Hoppers" (Technical Bulletin No. 372, pp. 94, fig. 18, pl. 4, U. S. Dept. Agriculture, Washington, D. C., August 1933) describes one typically Puerto Rican species, collected in abundance in several citrus groves in the Bayamón region, as **Agallia configurata**. It is "yellow cinereous to dirty yellow, with color varying considerably in intensity, but the pattern is constant and quite distinctive." Altho the type is from Puerto Rico, it occurs in the Dominican Republic, in Trinidad and even in Brasil.

Adult of *Agallia albidula* Uhler, twelve times natural size. (Drawn by G. N. Wolcott.)

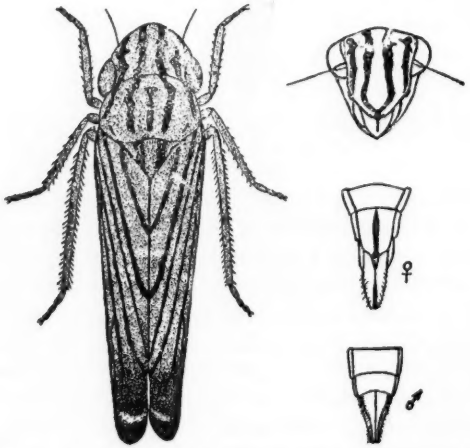
Agallia pulchra DeLong & Wolcott, the type collected on *Inga laurina* at Lares ("Insectae Portoricensis" 1924–259), has brighter colors than the others, and tends to be more abundant in coffee groves and on the tender growth of the coffee itself, and generally at higher altitudes, most abundantly perhaps at Indiera in the mountains above Yauco. It has been found on El Yunque, and also at sea-level at Guánica, on sugar-cane.

Agalliana sticticollis (Stål), first reported from Puerto Rico as *Agallia carrotovora* DeLong & Wolcott, has been found only in the San Juan region, swept from carrots, sweet potatoes and grass. It is much darker in general coloration than others of the Agalliinae in Puerto Rico.

Agalliopsis pepino, described as an *Agallia* by DeLong & Wolcott ("IP" 1924–258), the type from carpet grass (*Axonopus compressus*) at Ciales, others on sugar-cane at San Sebastián, has since been found at many localities, on various hosts and at light. Marked with black, its background is mauve to orchid, most obvious on the saddle on its back. Prof. J. H. Jensen (Mayagüez Station Report for 1937, p. 86) found it negative as vector of the bunchy top disease of papaya.

The very largest leafhopper ("length of male 9.75 mm.") in Puerto Rico is the pale green **Krisna insularis,** described by Dr. P. W. Oman (Pan-Pacific Entomologist, **12** (3): 118–9. San Francisco, Cal., July 1936) of which the type was collected by Dr. W. A. Hoffman on El Yunque, at light. Numerous subsequent collections have been made at light on El Yunque by Dr. Luis F. Martorell, and Prof. J. A. Ramos has swept them from herbage in the Maricao Forest. Aside from the "eyes and small areas around ocelli red or brown, anterior tibiae and tips of all tarsi tinged with reddish", these leafhoppers are "vividly virescent in life". An exceptionally large nymph, entirely light green, which is presumed to be of this species, was noted on *Eugenia stahlii* on the Mt. Britton trail, and this may be the normal host.

Idiocerus parvulus, described by Dr. Osborn (1935–132) from material at San Germán, is a much smaller pale green leafhopper, only 3 to 3.25 mm. long, noticeably colored with "a broad, pale orange spot partly divided on the median line" at the base of front. Prof. J. A. Ramos has made topotype collections, and also found it at Mayagüez and at Caguas.



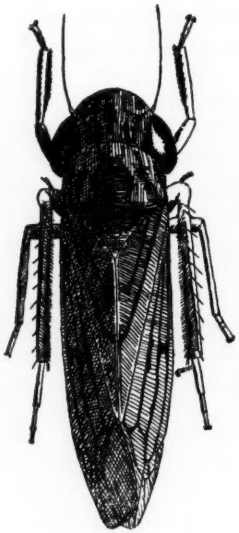
Adult of *Sibovia coffeaphila* (Dozier); ten times natural size.
(Drawn by H. L. Dozier.)

At present referred to the genus **Sibovia,** according to Dr. P. W. Oman, are three fine big leafhoppers of the Proconiinae, of which the two most common on coffee, and on other trees and shrubs of the coffee regions, were described by Dr. H. L. Dozier (Jour. Dept. Agr. P. R., **10** (3 & 4): 259–265, fig. 4. San Juan, September 1927) as **Cicadella coffeaphila** and **C. coffeacola.**

Subsequently, he (1931–6) transferred these to the subdivision *Entogonia*. Ecologically, these two are practically equivalent, both occupying the same niche and living on the same plants, but morphologically the latter is most obviously characterized by the black inverted Y on the back of its green head, rather than the more or less parallel black stripes of the other. Both are of the same intense shade of green. Dr. Osborn's **Entogonia lineata** (1935–136) from El Yunque is "fairly close" to the latter, but its stripes are narrower, and in life it is an opaque light yellowish green in color, quite different from the dense green of the other two. Subsequent collections have been made on "turma de toro" (*Clibadium erosum*) growing where the lower part of the Mt. Britton trail meets the jeep road to the radar station on El Yunque, the adults flying about from leaf to leaf much more actively than the coffee grove frequenting species. By comparison, these are inert, normally resting quietly on the stems or midribs of plants in considerable numbers. Nymphs associated with adults of *Sibovia coffeaphila*, and presumably this species, have been noted on *Heckeria peltata*, but this is not to be considered an exclusive host, for the stems of "fresas" (*Rubus rosaefolius*) and other valueless bushes occurring in coffee groves, as well as orange and "pomarrosa", also serve for them to rest and probably feed upon. Dr. Wetmore reports finding the bodies of 14 leafhoppers, identified as *Tettigonia* sp., in the digestive tract of the tody (*Todus mexicanus*). One of these birds collected by Dr. Luis F. Martorell in Bo. Maragüé, Ponce, had eaten seven leafhoppers which could be readily and definitely identified as *Sibovia coffeaphila*. If this is a minor pest of coffee, the presence of the tody is indicated as tending to produce effective control.

Poeciloscarta histrio (Fabricius), the presently accepted name for what for many years has been known as *Cicadella* or *Tettigonia sirena* Stål (= *T. interrupta* Signoret), is violet, old rose and purple marked with black, its head and the body beneath bright yellow. Of "The Minor Insects of Sugar-Cane of Porto Rico" (Jour. Dept. Agr. P. R., **5** (2): 1–47, fig. 19. San Juan, April 1921), it is by far the largest leafhopper to be found on young cane, but both nymphs and adults have been noted on other shrubs and plants and grasses, such as malojillo, gramma and sesame; on carrots, ñame and okra; on "cadillo" (*Urena lobata*), and bougainvillea vine; on "gallito" (*Agati grandiflora*), "almendra" (*Terminalia catappa*), coffee and grapefruit. Dr. Osborn (1929–93) found them on *Sesuvium* and *Barita*. "The nymphs have a median stripe of light yellow extending from the head to the tip of the abdomen, the younger ones being otherwise mostly dark brown, but the older ones are more yellowish brown, with various spots or stripes of darker yellow or brown, but nowhere showing the dark pink of the adults. In the field, there is no difficulty in connecting the nymphs with the adults, as they have invariably been found

together." Altho no collections have been made east of Pt. Cangrejos, Río Piedras, Comerío and Aguirre, the leafhopper is common elsewhere in the Island along the coast, even in the more arid regions, as at Ponce, Guánica and Faro de Cabo Rojo, and in the lower foothills up to Lares and Adjuntas. In the damp gorge at Guajataca, numerous dead adults were found killed by an *Isaria* fungus, festooned on the stems of *Lantana camara*. On Mona Island, adults were abundant on *Ricinus communis*, on various other unidentified plants, and attracted to light at night.



Adult of *Poeciloscarta histrio* (Fabricius) (= *Cicadella* or *Tettigonia sirena* Stål) twelve times natural size. (Drawn by G. N. Wolcott.)

Rainfall and humidity determine the abundance of **Hortensia similis** (Walker) on sugar-cane and grasses. First reported by Mr. D. L. Van Dine (1911–31) as a *Tettigonia*, and most often since as a *Kolla*, this most common leafhopper to be normally found on sugar-cane in Puerto Rico was most intensively studied at the time of the rapid spread of mosaic disease, for it seemed to be the most likely vector of the disease. The adult is bright grass green, with a characteristic and very definite pattern in black on the head and prothorax. The eggs are laid in clusters of from three to seven in cane leaf tissue, and can easily be seen when the leaf is held up to the light. They are parasitized by *Brachistella prima* Perkins, *Ufens niger* Ashmead and *Oligosita comosipennis* Girault; those escaping

parasitism hatching in seven days. "The just hatched nymphs are opalescent, light creamy-yellow, with big, darker eyes and are first noted on the central whorl of the cane. They feed nearly half of the time. With their thick beak inserted in the cane plant, they let go with their legs, using them to get rid of the minute drop of colorless excrement which collects at the anus. With all their legs in motion at once and these little drops of moisture being hurled into the air at the rate of one every seven seconds, a colony of *Kolla similis* nymphs feeding is a most exciting spectacle."

Adult of *Hortensia similis* (Walker), twelve times natura' size.
(Drawn by G. N. Wolcott.)

All kinds of terrestrial and arboreal lizards feed on the adults, but no bird, nor the giant toad. Dead adults have been found apparently killed by a fungus, *Empusa muscae* Cohn. During dry weather, these leafhoppers apparently retreat to the wettest parts of malojillo meadows, but under favorable conditions of humidity they may be found in cane fields at Guánica, on the grasses around Cartagena Lagoon and even at Faro de Cabo Rojo. Prof. J. A. Ramos collected a single adult at light on Mona Island.

Kolla fasciata Walker (= *Kolla fuscolineela* Fowler), characterized by a head broadly banded with black and yellow, and pink beneath, normally lives on lawn and pasture grasses, such as St. Augustine, Bermuda and

carpet grasses, and only incidentally and accidentally on malojillo and young sugar-cane. Altho found near the coast, it tends to be more abundant in the hills, on pastures or patches of grass in coffee groves. Its nymphs are fluffy white, and often more abundant on a favored bit of lawn than are the adults. Being very sensitive to local humidity, it shows what has been termed a "Leafhopper Reaction to Lawn Sprinkling" (Jour. Ec. Ent., **33** (3): 584. Menasha, June 1940) so marked as to be very destructively abundant when this is artifically increased. It is eaten by the grass lizard often, and more rarely by other lizards.

Adult of *Kolla fasciata* Walker (= *Kolla fuscolineela* Fowler). Twelve times natural size. (Drawn by G. N. Wolcott.)

Carneocephala sagittifera (Uhler), in the earlier records called a *Draeculacephala*, was noted by Dr. Osborn (1929–93) as greatly preferring Bermuda grass, and numerous collections have been made on this host in all parts of the Island. It has been found on sugar-cane at Guánica and Hormigueros, but its presence on this host was largely accidental, having been forced by weeding. Characterized by a very sharply pointed head and a consistent pattern of black spots on head and scutellum, its wings vary in depth of intensity of their grey coloration. The grass lizard (*Anolis pulchellus*) eats these leafhoppers, and rather surprisingly, the iguana (*Ameiva exsul*) also catches them.

The females of **Xerophloea viridis** (Fabricius) are entirely green, with

their hyaline wings so tightly drawn together that the hind end of the body is very acute. The males are marked with reddish, and the ocelli are red. Altho a common continental species, in Puerto Rico it is but rarely noted. Dr. Osborn records it from Desecheo Island, and from Guánica, Ponce, Aguirre and Guayama. It is by no means confined to the xerophytic south coast, however, for Dr. Richard T. Cotton swept it from the patch of carrots at Rio Piedras which he found inhabited by so many different kinds of leafhoppers and other insects, and the crested lizard (*Anolis cristatellus*) also found it at Río Piedras.

Adult of *Carneocephala sagittifera* (Uhler), twelve times natural size. (Drawn by G. N. Wolcott.)

The only other representative of the Gyponinae in Puerto Rico is the much smaller **Xerophloea breviceps,** described by Dr. Herbert Osborn (1935–143) from a single male at San Juan, which "approaches the gray-colored male of *viridis*, but is much smaller, the vertex shorter and less angulate."

Xestocephalus pulicarius Van Duzee, 2.5 to 3 mm. long, is one of the smallest of the Euscelinae: minute brown leafhoppers, speckled with grey and white. It occurs at every elevation, from Pt. Cangrejos and Aguirre on the north and south coast, to Indiera in the mountains above Yauco, but is possibly most abundant in coffee groves. Altho comparatively few collections have been made by entomologists, all the arboreal lizards: *Anolis evermanni*, *A. pulchellus*, *A. krugii*, *A. stratulus*, *A. cristatellus* and *A. gundlachi*, were found to have eaten this little leafhopper. Presumably it is as abundant as their collecting indicates.

Xestocephalus pallidus, 2.5 mm. long, was described by Dr. Osborn (1935–146) from a single female collected on El Yunque.

Xestocephalus maculatus, 3.5 mm. long, was described by Dr. Osborn (1929–94) from an abundance of specimens found on *Inga vera* near Jájome Alto, shade trees for coffee groves since almost entirely destroyed by hurricane.

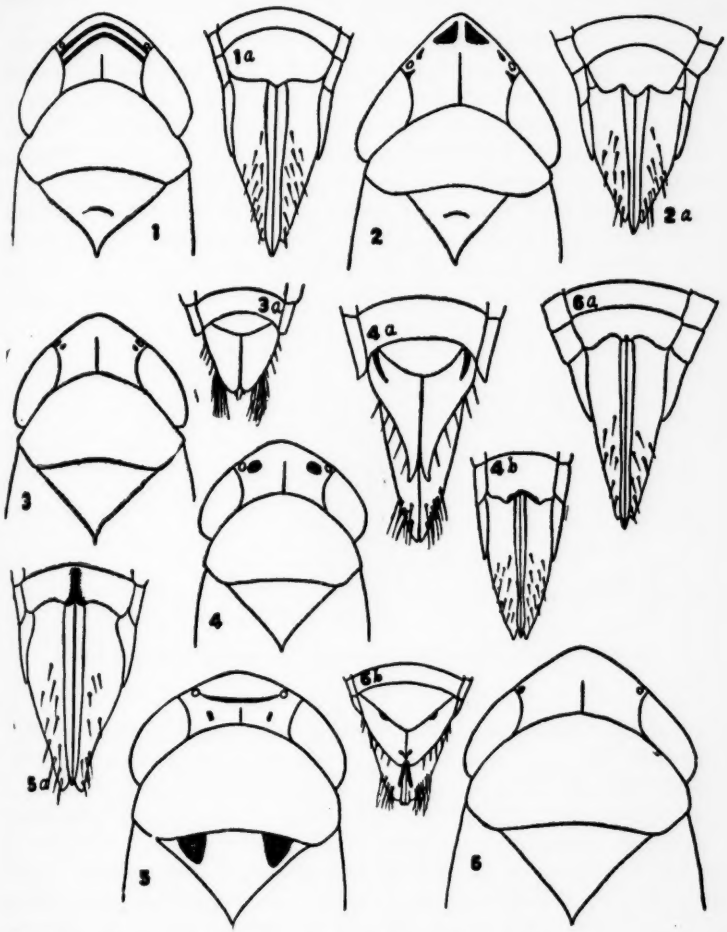
Adult of *Xestocephalus pulicarius* Van Duzee, twelve times natural size. (Drawn by G. N. Wolcott.)

By contrast with these quaint little spotted species, **Spangbergiella vulnerata** (Uhler) is one of the largest, the female having a remarkably broad and expanded head. Both sexes characteristically have orange-red, converging, diagonal stripes on a light green vertex and pronotum. They are sometimes attracted to light, and have also been noted on young cane, malojillo and other grasses, Dr. Osborn mentioning Guinea grass. Not at all abundant, the localities from which collections have been made are Camuy, Aguirre, Río Piedras, Loíza and Vieques Island.

Most remarkably patterned in yellow, brown and grey is **Sanctanus fasciatus** described by Dr. Osborn (1900–190) as a *Scaphoideus* from specimens from Haiti and many from the southern United States, and its Puerto Rican variety described by Dr. Osborn (1935–149) as **variabilis**, the type from Aguirre, others from Patillas.

Osbornellus bimarginatus, described by Dr. D. L. DeLong ("IP" 1924-261) as a *Scaphoideus*, the type from light at Pt. Cangrejos, was supposed to be only a coastal species, like those above, but Prof. J. A. Ramos has collected specimens in the Maricao Forest, as well as at Mayagüez.

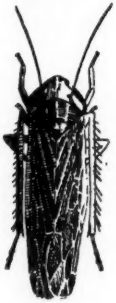
The grey and yellow spotted **Scaphytopius loricatus** (Van Duzee), most recently collected by Prof. Ramos on Mona Island, and **Scaphytopius frontalis** (Van Duzee) have to date been found only near the coast in Puerto Rico. As a *Platymetopius*, Dr. Osborn (1935–150) records finding two specimens on waste land at Aguirre, and assigns to the latter the record "on string beans at Rio Piedras," very scanty records considering that



Leafhoppers illustrated in "Insectae Portoricensis" (1923–262).
1. *Osbornellus bimarginatus* (DeLong), 1a. female genitalia.
2. *Deltocephalus trilobatus* DeLong, 2a. female genitalia.
3. *Deltocephalus flaveolus* Osborn, 3a. male genitalia.
4. *Baldulus maidis* (DeLong & Wolcott), 4a. male genitalia, 4b. female genitalia.
5. *Chlorotettix nigromaculatus* (DeLong & Wolcott), 5a. female genitalia.
6. *Chlorotettix tethys* Van Duzee, 6a. female genitalia, 6b. male genitalia. (Drawn by D. M. DeLong.)

"the species is common over the southern United States and in Central America."

Six species of **Deltocephalus** have been collected in Puerto Rico: **albivenosus** Osborn, from beach grasses at Luquillo, San Juan and Añasco; **flaveolus** Osborn, the type from Cuba, but collected by Prof. J. A. Ramos at light at Mayagüez, and considered by him identical with *nigripennis* DeLong ("IP" 1924–263), the type of which was from grass at Boquerón; **flavicosta** (Stål), sufficiently abundant on beach grasses, malojillo and sugar-cane to form an appreciable item in the food of four lizards: *Anolis pulchellus, A. evermanni, A. stratulus* and *A. cristatellus;* **maculellus** Osborn, collected by Dr. Osborn at Guayama, Coamo and Fortuna, and by Prof. J. A. Ramos on Mona Island; **sonorus** Ball, from grass at Aguirre by Dr. Osborn (1929–



Adult of *Deltocephalus flavicosta* (Stål), twelve times natural size. (Drawn by G. N. Wolcott.)

95) and from malojillo at Pt. Cangrejos; and **trilobatus** DeLong ("IP" 1924–263), the type from Pt. Cangrejos, subsequently collected by Dr. Osborn (1929–95) on scanty pasture grasses in the hills north of Salinas, at lower elevations at Arecibo, Aguirre and on the beach at Sabana Abaca.

Exitianus obscurinervis (Stål) is sufficiently common elsewhere in tropical America to be a serious pest on grasses, according to Dr. Osborn (1929–96), who found both nymphs and adults present on practically all grasses in Puerto Rico "except perhaps for Guinea grass." As *Athysanus exitiosus* Uhler, determined by Dr. J. D. Ball, it had earlier been recorded on sugar-cane at Patillas and Hatillo, so rarely indeed, as unquestionably not implicated in mosaic disease transmission.

Limotettix striolus (Fallen), identified in 1920 by Dr. D. L. DeLong as an *Euscelis* or *Athysanus*, was found in abundance on malojillo grass at Pt. Cangrejos, but has not since been collected.

Acinopterus angulatus Lawson, first reported from Puerto Rico as

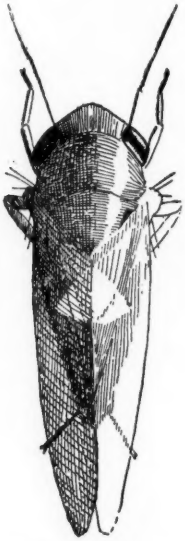
Acinopterus acuminatus Van Duzee, determined by Dr. D. L. DeLong, swept from grass at Boquerón, was later collected by Dr. Osborn (1935–159) at Guayama and Salinas, and a single specimen from San Juan identified as this species.

Adult of *Exitianus obscuriner is* (Stål) (= *Athysanus exitiosus* Uhler), twelve times natural size. (Drawn by G. N. Wolcott.)

Adult of *Unerus colonus* (Uhler), twelve times natural size. (Drawn by G. N. Wolcott.)

Unerus colonus (Uhler), in earlier Puerto Rican records called a *Thamnotettix*, is distinctive with two small and two larger black spots on the vertex. It is quite common on all sorts of grasses, possibly the first record being of one individual, misidentified as *Tettigonia similis* Walker, reported by Dr. John R. Johnston as killed by *Empusa muscae*, one of "The Entom-

ogenous Fungi of Puerto Rico" (Bull. No. 10, Board of Commissioners of Agriculture, P. R., pp. 1–33, pl. 9, fig. 1. San Juan, 1915). As an indication of its abundance, one individual was collected in 3 square feet of pasture at Pt. Cangrejos, and it was found eaten by the grass lizard *Anolis pulchellus*, and by *Anolis krugii*. It occurs on young sugar-cane, and on malojillo, but is most abundant in the hills on carpet grass, *Axonopus compressus*. Dr. Osborn (1929–97) found it on Bermuda and St. Augustine grasses at many localities, its most recent collection being by Prof. J. A. Ramos on Mona Island.



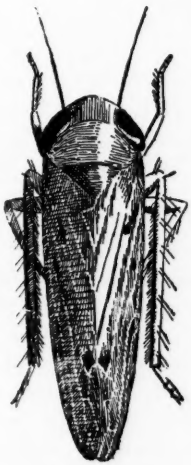
Adult of *Chlorotettix minimus* Baker, twelve times natural size.
(Drawn by G. N. Wolcott.)

Unerus cubanus (Osborn), described from Cuba as *Thamnotettix*, has smaller spots on its head and is generally much less abundant. Dr. Osborn (1929–97) collected it on grasses at Guayama and Aguirre, and Prof. J. A. Ramos found it on Mona Island.

Unerus comatus (Ball), described from Mexico as a *Deltocephalus*, was tentatively determined by Dr. D. L. DeLong as a *Thamnotettix* from Puerto Rican material. Dr. Osborn (1929–98) swept these yellow-green leafhoppers from grass at Bayamón and Arecibo. The spots on the vertex are smaller than those on *U. cubanus*, and much smaller than the larger pair on *U. colonus*.

Eutettix tenellus (Baker), the beet leafhopper of the western United States, according to Dr. P. W. Oman, (Proc. Ent. Soc. Washington, **38** (7): 164–5. Washington, D. C., October 1936), the *Thamnotettix rubicundula* Van Duzee of Jamaica, which Dr. Osborn (1929–98) collected on "verdolaga rosada", (*Sesuvium portulacastrum*) at Aguirre and Ensenada, has since been found at Boquerón on "verdolaga de mar" *Sesuvium maritimum*.

Graminiella nigrifrons (Forbes), a pale yellowish-green leafhopper with a blackened face, is a common continental species of which Dr. Richard T. Cotton swept a few specimens from carrots at Río Piedras and of which Dr. Osborn (1929–98) made collections at Santa Rita, Luquillo and Loíza Aldea.



Adult of *Chlorotettix tethys* Van Duzee, twelve times natural size. (Drawn by G. N. Wolcott.)

Chlorotettix minimus Baker, a large pale green leafhopper, is often found on young sugar-cane, but is normally much more abundant on grasses, Dr. Osborn (1929–99) having collected it at many coastal localities.

Chlorotettix nigromaculatus DeLong & Wolcott ("IP" 1924–265), of which the type was collected at light at Río Piedras, was not found by Dr. Osborn, but Prof. J. A. Ramos has many specimens taken at light at various localities, including Mayagüez and Ponce.

Chlorotettix tethys Van Duzee, re-described from Puerto Rican specimens collected at Pt. Cangrejos and Guánica by Dr. D. L. DeLong ("IP" 1924–

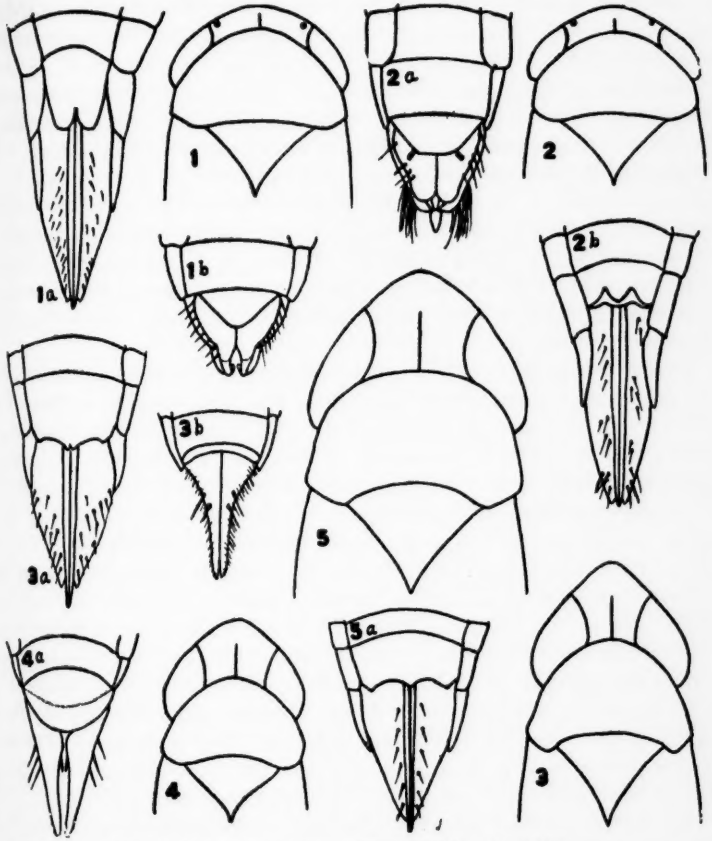
264) with the specific name of *bidentatus*, is light green in color, devoid of markings except for "more or less distinct fuscous or blackish spots on the elytra" according to Dr. Osborn (1929–99), who found the nymphs associated with adults on the mountainside of the Salinas valley, "bright green, no marking, with short scattered blackish hairs on abdomen". Adults do occur on young sugar-cane but are most abundant on grasses, and may occur on weeds and sweet potatoes. They have been found eaten by the grass lizard, *Anolis pulchellus*. Prof. J. A. Ramos found them on Mona Island.

Chlorotettix viridius Van Duzee, entirely light green in color, was first collected in Puerto Rico at light at Pt. Cangrejos, Dr. Osborn (1929–99) found only one specimen at Luquillo.

Jassus obligatus, described and figured by Dr. Osborn (1935–167), using Uhler's MS name, was from a single type collected on "jagüey" (*Ficus laevigata*) by G. N. Wolcott at Quebradillas. It is a large brown leafhopper, striped with red, of which only one other specimen has been collected in Puerto Rico, by Mr. R. G. Oakley from "roble" (*Tabebuia pallida*) in the Ponce region. Specimens in the U. S. National Museum bearing Uhler's MS name are from Grenada.

Baldulus maidis, described as a *Cicadula* by DeLong & Wolcott ("IP" 1924–265), first collected on corn at Haina, Dominican Republic in 1920, but the type from San Sebastián in Puerto Rico, on corn, may be identified by the two round black spots on the vertex, one just behind each ocellus. Corn is the normal host, but this leafhopper may also be found on young cane, and Dr. Richard T. Cotton swept it from carrots at Río Piedras. Dr. Osborn found it at Guayama on corn, but not elsewhere in the south coast, altho it is common and almost invariably present on this host on the more humid parts of Puerto Rico. It also occurs in Cuba, and has been accidentally introduced into California. Mr. D. B. Mackie, reporting in the "Insect Pest Survey" (**14** (9): 284. Washington, D. C., November 1, 1934), found it "in the eight southern counties from Kern and Santa Barbara to the Mexican border". Most recently, Dr. P. W. Oman, reporting on the "Distribution of *Baldulus maidis* (DeLong and Wolcott)" (Proc. Ent. Soc. Washington, **50:** (2): 34. Washington, D. C., February 27, 1948), notes that this leafhopper has also been found in Arizona, Texas, Florida and North Carolina in the United States, and in Mexico, Costa Rica, Venezuela, Brasil, Perú and Argentina, being a pest of sugar beets at Tucumán. It seems highly improbable that it occurred in any of these continental countries originally, but the records of collection are too scattered to draw any conclusions as to the point of first introduction from the West Indies. Adults have been attracted to light, but nymphs occur mingled with the adults only on corn, often in sufficient numbers to caus-

injury comparable to that of the corn fulgorid. Both nymphs and adults are parasitized by a blue-green strepsipteran, and Dr. K. A. Bartlett reports *Gonatopus* near *bicolor* Ashmead, "A Dryinid Parasite attacking *Baldulus maidis* in Puerto Rico" (Jour. Agr. U. P. R., **22** (4): 497–8. Río Piedras, February 1938).



Leafhoppers illustrated in "Insectae Portoricensis" (1923–268).

1. *Nesosteles guajanae* (DeLong & Wolcott), 1a. female genitalia, 1b. male genitalia.
2. *Nesosteles incisa* Matsumura, 2a. male genitalia, 2b. female genitalia.
3. *Protalebra aureovittatus* (DeLong), 3a. female genitalia, 3b. male genitalia.
4. *Empoasca sexmaculata* DeLong, 4a. male genitalia.
5. *Joruma brevidens* (DeLong), 5a. male genitalia. (Drawn by D. M. DeLong.)

Macrosteles sexnotata (Fallen), in the earlier Puerto Rican records listed as a *Cicadula*, was first collected on sugar-cane at Patillas and Garrochales but its normal host is grasses. Dr. Osborn (1929–100) collected a possible variety at Jájome Alto, between Cayey and Guayama, of which the six spots on the vertex are "broader (and) more squarish".

Balclutha hyalina Osborn, the type of which was from a sedge in Cuba, was found by Dr. Osborn (1929–101) at Jájome Alto, but has not since been collected in Puerto Rico.

Balclutha abdominalis Van Duzee, a widely distributed continental leafhopper, was reported by Dr. Osborn (1929–101) as a *Eugnathodus* from Lares, Mayagüez, Arecibo, Río Piedras, Jájome Alto and Fortuna.

Nesosteles calcarus (DeLong & Davidson), described originally from Miami, Florida, is listed from Puerto Rico in "A Review of the North American Species of *Balclutha* and *Agellus* (Homoptera: Cicadellidae)" (Proc. Ent. Soc. Washington, **37** (5): 97–111, pl. 2. Washington, D. C., June 24, 1935) by the original describers. It resembles "*neglectus* in form, size and appearance, but distinguished by . . . a large spine on each pygofer."

Nesosteles flavidus (Osborn), identified as a *Eugnathodus* by Dr. P. W. Oman, is known only in Puerto Rico from specimens collected at Naguabo.

Of all the delicate little leafhoppers with opalescent wings, most of which were described as belonging to the genus *Eugnathodus* or *Agellus* and are now placed in the genus *Nesosteles*, the one of possibly greatest economic importance is that most often found in the seed-heads or "arrows" or "guajanas" of sugar-cane, **Nesosteles guajanae** (DeLong). Even before it had been described, Mr. E. G. Smyth (1919–107) had noted its abundance and considered it "a principal cause of the low fertility of the seed. For this reason it may be a serious retarding factor in the production of new cane varieties. The nymphs, which are dark in color with lighter dorsal stripe, could be shaken by the thousands from a single cane seed tassel." They are heavily preyed upon by the larvae of a Syrphid fly, *Allograpta limbata* Fabricius. Altho the type was from Río Piedras, others were from Vega Alta, Aguadilla and Vieques Island, and Prof. J. A. Ramos has collected it on Mona. In Cuba it occurs "en el güin de la caña": merely another name for "guajana" of Puerto Rico and "arrow" of the British West Indies. Dr. Osborn (1929–102) collected it "frequently in sweeping grass even when far distant from cane, and it seems evident that it is a general grass feeder and occurs on cane only when it is in bloom." It can hardly be common on grasses, for the grass lizard, *Anolis pulchellus*, was not observed to have eaten any leafhopper which could be identified as this.

Nesosteles incisa Matsumura first listed under this name by Dr. F. M. Wadley (1937–107) as being swept from grass in the Mayagüez region, was

described by Dr. D. L. DeLong ("IP" 1924–266) as *Eugnathodus bisinuatus* from a large series of specimens from seedheads of malojillo (*Panicum barbinode*) at Río Piedras, and had earlier been listed as *Balclutha osborni* Van Duzee on sugar-cane and malojillo. Incidentally and accidentally, it may also occur on other low vegetation, such as sedges, carrots and sweet potatoes, but is primarily a grass-infesting leafhopper, and as such is eaten by the grass lizard, *Anolis pulchellus*. Prof. J. H. Jensen (Mayagüez Station Report for 1937, p. 86) pronounced it negative as vector of the bunchy-top disease of papaya.

Nesosteles minutus, described by Dr. Osborn (1929–101) as a *Eugnathodus*, "from matted grass at sea level, salt flat association, at Aguirre" is 2.5 to 2.75 mm. long, the smallest of the genus, a pale ashy grey leafhopper, almost white. It has not since been found.

Nesosteles neglectus (DeLong & Davidson), a pale or dark brown leafhopper originally described from Mt. Manitou, Colorado and found in most of the United States, and the Canal Zone, was listed by Dr. Osborn (1929–101) from numerous localities in Puerto Rico under the name *Eugnathodus abdominalis* Van Duzee. Later (1935–176) he decided "the true *abdominalis* to be a *Balclutha*" and revised his records of collections to include only Aguirre, Fortuna and Arecibo.

Nesosteles pallidus (Osborn), which is not the DeLong & Davidson variety of their *neglectus*, is reported from Puerto Rico by Dr. Osborn (1929–101) as a *Eugnathodus*, from specimens collected at Río Piedras and later transferred (1935–174) to *Nesosteles*, with illustration and notes as to its pale olive green color, the elytra milky hyaline.

"From the seed heads of a sedge, *Fimbristylis spadicea*, at Aguirre" Dr. Osborn collected the types of **Nesosteles rosaceus** (1929–102), thus named because "the whole body above and beneath, as well as the elytra, (is) suffused with bright pink or reddish rose color". Originally called a *Eugnathodus*, Dr. Osborn (1935–175) is responsible for the generic transfer.

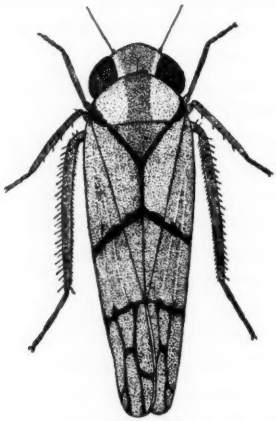
Nesosteles virescens, originally described by Dr. Osborn from Cuba as a *Eugnathodus*, was collected by him (1929–101) from the grass on the Station grounds at Río Piedras.

Of the delicate, small, milky whitish or light green Typhlocybinid leafhoppers, those of the genus *Protalebra* are usually specific on the leaves of a tree. Dr. D. L. DeLong ("IP" 1924–267) described **Protalebra aureovittatus,** as an *Alebra*, from a tree in Ciales which presumably was the "moral" (*Cordia sulcata*), as this leafhopper has repeatedly been collected since from this host: at Yabucoa, Río Grande, El Yunque, Cayey and Aguas Buenas.

Protalebra bifasciata Gillette, as determined by Mr. W. L. McAtee, was reported by Dr. H. L. Dozier (1927–261) "from a thorny leguminous bush in a ravine near Juana Díaz", but has not since been found.

Protalebra cordiae, described by Dr. Osborn (1929–102) from an abundance of nymphs and adults on the under side of the leaves of *Cordia* at Aguirre and Coamo, were presumably from "capá prieto" (*Cordia* or *Cerdana alliodora*), from which this leafhopper has since been collected at Cayey and San Lorenzo. It is mostly white, marked with yellow and orange, the elytra tinged with greenish; the nymphs are "white, faintly tinged with yellow, the eyes greenish white as in the adults".

Protalebra tabebuiae described by Dr. H. L. Dozier (1927–260) from an abundance of nymphs and adults living on the under side of the leaves of "roble" (*Tabebuia pallida* = *Tecoma pentaphylla*) at Río Piedras, has been



Adult of *Protalebra tabebuiae* Dozier, twenty times natural size.
(Drawn by D. H. Dozier.)

repeatedly noted since on this host, not only at Río Piedras, but wherever the trees occur. At times it is so abundant as to produce a mosaic-like pattern on the leaves that finally blots out most of the normal dark green and causes some of them to drop long before they would normally do so. Those which continue to adhere, are badly spotted, or often entirely yellow. Following the first heavy spring rain that causes complete defoliation, a major infestation of leafhoppers often appears on the tender new leaves, producing feeding injuries even before they have attained full size. It has been suggested that this leafhopper may be the vector of the witches broom disease of roble.

Protalebra braziliensis Baker, first reported from Puerto Rico as *Erythroneura comes* Say, is a "brilliant little yellow-and-brown leafhopper with silvery spots in the brown blotches" which is sometimes very abundant on young sugar-cane in weedy, sandy fields in low places, especially where the

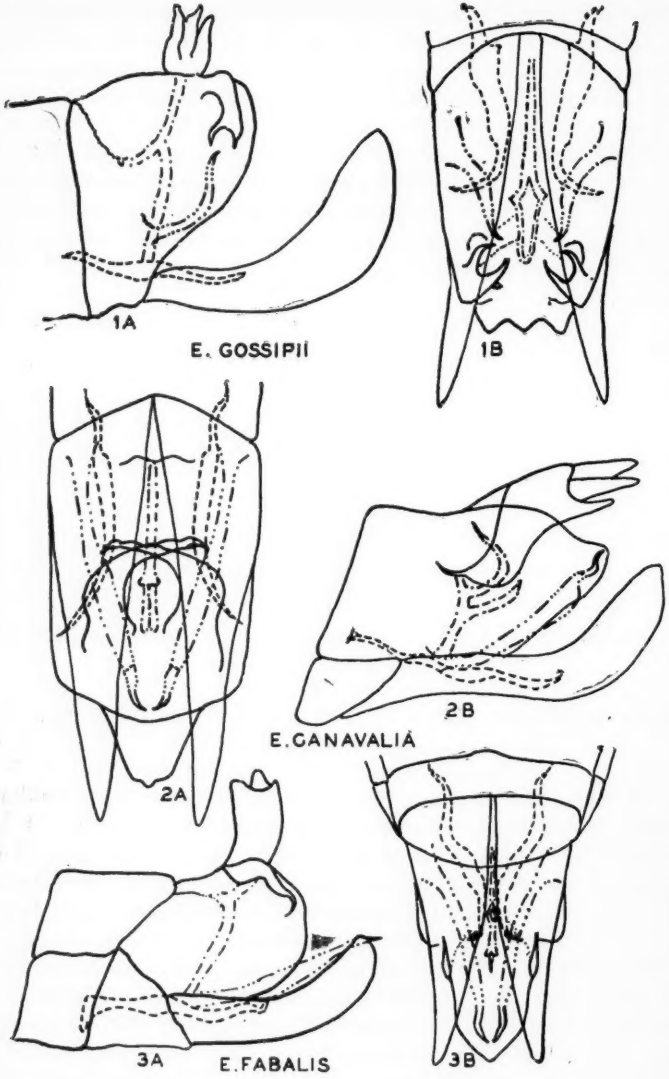
coarse composite weed "manzanilla" (*Wedelia trilobata*) is growing on the margins of the fields. This plant is a specific host, for on it will also be found the nymphs, "all yellow with indistinct olive-green markings on the thorax, five rows of brown hairs on the abdomen, black claws and light green eyes".

In addition to these species of which the host is known, Dr. Osborn (1929–103) described **Protalebra lenticula** from Coamo, **Protalebra ziczac** from Añasco, and records **Protalebra similis** Baker from sweet potato at Vega Baja. Subsequent collections of the three, usually at light, from other localities give no indication of the normal host.

Adult of *Protalebra braziliensis* Baker, twelve times natural size. (Drawn by G. N. Wolcott.)

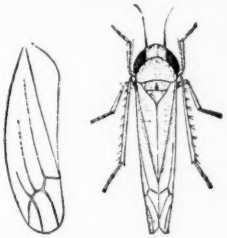
Protalebra brunnea, one of the "New Eupterygine Leafhoppers from Puerto Rico (Homoptera: Cicadellidae)" (Jour. Agr. U. P. R., **21** (4): 567–71, pl. 1. Río Piedras, November 12, 1937) described by Dr. P. W. Oman, is dark brown in color, collected at Villalba by Mr. R. G. Oakley.

Empoasca fabalis, described by Dr. Dwight M. DeLong as "A New Species of Bean Leafhopper from Haiti" (Canadian Entomologist, **62** (4): 92–3, fig. 2. Orillia, April 1930) "resembling *fabae* in size, form and appearance, but with distinct genital characters; size 3.0 mm; color pale green without distinct markings, usually with irregular mottling and varying longitudinal stripes, white; a pair of oblique dark green spots either side of and back of apex" was "from a series of more than sixty specimens collected at Port-au-Prince, Haiti, April 15 and June 18, 1929 by Dr. R. C. Smith. He reports these as extremely abundant upon beans and sweet potatoes and the most important species of economic leafhopper in Haiti upon truck crops". As is noted by Dr. John S. Caldwell in discussing "The Synonymy of *Empoasca fabalis* DeLong (Cicadellidae: Homoptera)" (Jour. Agr. Univ. P. R., **31** (2, April 1947): Río Piedras), the common leaf-



Lateral and ventral views of male genitalia of three species of *Empoasca* leafhoppers originally described from Haiti by Dr. D. M. DeLong, two of which are known to occur in Puerto Rico. (Drawn by D. M. DeLong.)

hopper on beans in Haiti, as in Puerto Rico, is *fabae* (Harris), and that on sweet potatoes and morning glory in Haiti, as in Puerto Rico, is what was subsequently identified as *batatae* Poos, which is a synonym of *fabalis* DeLong. Indeed, this is indicated in the confused records, Dr. Herbert Osborn (1935–185) noting that "the species is abundant and injurious on sweet potato, beans, morning glory, etc., etc.," which is quite correct if the record of beans is omitted, for late identifications have been made by Dr. P. W. Oman of leafhoppers from sweet potatoes, and from morning glory, as being *batatae* Poos. Three years after the description of *Empoasca fabalis* was published, Dr. F. W. Poos described his *batatae* from "a large series of specimens reared on sweet potato at Arlington, Va., and from specimens collected as nymphs from the same host plant at Fort Myers, Florida. Specimens were also received from Brasil, collected on cotton,



Forewing and adult of *Empoasca fabalis* De Long, ten times natural size. (U. S. Bureau of Entomology.)

grohoma, legumes and sweet potato". The record on cotton presumably refers to what is locally called "algodão brava", which, illogically enough, is in fact a morning glory, *Ipomaea fistulosa.*

Empoasca fabae (Harris) is the common bean leafhopper. The enormous numbers in which this small, light green leafhopper occurs is the main reason why beans can not be grown at sea level in the West Indies during the summer. Presumably a very exact temperature relation is involved, for beans do well in the winter along the coast, and at all times of year in the mountains. But summer temperatures in the lowlands of Puerto Rico appear to be optimum for a tremendous increase in abundance of these iridescent and opalescent-winged leafhoppers, which directly by their feeding, and indirectly by transmitting a presumed mosaic disease, prevent beans from reaching maturity. In the report by Drs. Roger C. Smith & H. D. Barker on their "Observations on the "Yellows" Disease of Beans and related Plants in Haiti" (Jour. Ec. Ent., **23** (5): 842–7, pl. 1. Geneva, October 1930), they did not prove that the real cause is a virus of which the leafhopper is merely the vector, but merely suggested that probability.

Beans have many advantages as a catch crop in gran cultura plant cane, but in young plant cane in the spring and early summer, they are often a total loss. Spraying with Bordeaux mixture as often as on potatoes might be equally effective, but can hardly be justified economically. Spraying or dusting with DDT and some of the other newer insecticides is so effective in control of leafhoppers that it is now possible to grow beans at all times of the year at sea level in the tropics, but this is such a recent development that few growers have attempted it commercially.

A comparable yellowing and shedding of leaves is caused by this leafhopper on the leguminous tree "gallito" (*Agati grandifiora*). Premature defoliation of small-seeded lima beans (Mayagüez Station Report for 1939, p. 60) is also caused by this leafhopper, but plants of the large-seeded lima beans were apparently uninjured. Altho beans are the normal host of this species, individuals identified by Dr. P. W. Oman have been taken from melon, tomato and malojillo, *Panicum purpurascens*.

Empoasca minuenda Ball, as determined by Dr. H. L. Dozier (1927–261), was found "abundant on the undersides of avocado leaves at Río Piedras", having been earlier definitely identified from this host at Río Piedras, and subsequently at Loíza. Dr. P. W. Oman has also identified as this species specimens intercepted on grapefruit at Arecibo, on "maga" (*Montezuma speciosissima*) as var. *moznetti* Ball, and as doubtfully this species on "anona blanca" (*Annona diversifolia*).

Empoasca sexmaculata was described by Dr. D. M. DeLong ("IP" 1924–270) from a pair on "emajagua" (*Pariti tiliaceum*), at Pt. Cangrejos, out of large numbers noted causing yellowing of the leaves, with large and small nymphs also present. This characteristic yellowing together with the accompanying leafhoppers, will be noted on almost every plant in all parts of the Island where it grows.

Empoasca papayae was described by Dr. P. W. Oman (1937–570) from specimens collected at Mayagüez on papaya (*Carica papaya*) by Dr. J. H. Jensen, who, however, failed to implicate them in the transmission of the bunchy top disease of the host. Subsequently, Mr. José Adsuar was able to prove the "Transmission of Papaya Bunchy Top by a Leafhopper of the Genus *Empoasca*" (Science, **103** (2671): 316. Lancaster, March 8, 1946) using individuals collected on papaya at and near Río Piedras. The females of this species are practically indistinguishable from others of the genus. By etherizing mass collections of leafhoppers from papaya, Mr. Francisco Seín was able to separate out males of *Empoasca papayae*, and using these males only as vectors, transmission of the disease was obtained. (Science, **106** (2745): 130. Baltimore, August 8, 1947). As these leafhoppers are generally not at all abundant on papayas growing near the beach, on such plants the disease seldom appears. At Río Piedras the disease is severe, leafhoppers being very abundant at times, altho periods

of scarcity also occur. Farther inland, as at Toa Alta, Comerío, Corozal, Caguas and Cayey, the leafhoppers have been noted in greatest abundance. This is not altogether a matter of altitude, for at Punta Borinquen Air Base, at an elevation of several hundred feet, but close to the ocean, very few leafhoppers were to be found on universally healthy papayas. Dusting healthy papaya plants, when small, with 5% DDT at intervals of two weeks is effective in killing the leafhoppers, or preventing their becoming abundant, and it is anticipated that such DDT-treated plants should be able to attain maturity and produce fruit without becoming diseased. Miss Vera K. Charles has identified as *Empusa spiculata* Thaxter, var. *major* a fungus killing these leafhoppers, which may be partly responsible for their scarcity under conditions and in regions where one might expect them to be numerous.

The type of **Empoasca insularis,** described by Dr. P. W. Oman as one of "New Neotropical Empoascan Leafhoppers" (Jour. Washington Academy of Science, **26** (1): 34–40, fig. 2. Washington, D. C., 1936), is from Puerto Rico.

In "Studies on the Host Plants of the Leafhoppers of the Genus *Empoasca*" (Technical Bulletin No. 850, U. S. Dept. Agr., pp. 51, fig. 21, ref. 130. Washington, D. C., May 1943), Drs. F. W. Poos and N. H. Wheeler record from Puerto Rico **Empoasca sativae** Poos from *Centrosema* and *Indigofera*, and quote records by Dr. Osborn of **Empoasca fabae** Harris definitely identified by Dr. D. M. DeLong from Lares and Cataño, and of **Empoasca gossypii** DeLong on cotton at Añasco.

The type of **Joruma brevidens,** described as an *Empoasca* by Dr. D. M. DeLong ("IP" 1924–269) was from young coffee leaves at Indiera, in the mountains north of Yauco. The single specimen collected by Dr. Osborn (1929–105) was at Loíza Aldea, sweeping the river margin near caña brava, indicating a wide range in ecological habitats.

The type of **Joruma neascripta,** described by Dr. P. W. Oman (1937–568), was collected on "icaco" (*Chrysobalanus icaco*) at Manatí.

Joruma pisca McAtee, as determined by Mr. W. L. McAtee, was collected by Dr. H. L. Dozier (1927–262) at Aguirre.

Largely eliminating the West-Indian cedar or "cedro" (*Cedrela odorata* or *Cedrela mexicana*) from consideration as an economic tree in Puerto Rico is another of these little light green leafhoppers, first noted as a serious pest here, and described by Dr. P. W. Oman (1937–569) from a great abundance of material collected at Doña Juana (Villalba), Aibonito and Maricao Forest as **Dikraneura cedrelae**. It becomes so abundant on the underside of cedro leaves as to cause their premature yellowing and shedding everywhere that this tree has been planted by the Forest Service. The caterpillars of the mahogany shoot borer, *Hypsipyla grandella* Zeller, also attack young cedro trees. The combined effect of attack by two pests:

one causing premature shedding of the leaves, the other causing low branching, effectually prevent the cedro from rapidly developing marketable lumber anywhere in Puerto Rico. The shoot-borer is cosmopolitan, but the leafhopper occurs elsewhere only in Cuba, where it is considered but a minor pest.

As **Dikraneura centrosemae** (the specific name mis-spelled *lentrosemae* in the text of the original description) Dr. P. W. Oman (1937–568) described the leafhopper which Dr. F. M. Wadley had swept from *Centrosema* at Mayagüez.

Dikraneura marginella Baker was swept from grass at Río Piedras by Dr. Osborn (1929–106).

Often very common on the underside of the leaves of "maga" (*Montezuma speciosissima*) are the red, white and blue nymphs and the bright colored adults of **Dikraneura (Hyloidea) depressa,** described by Mr. W. L. McAtee (Jour. N. Y. Ent. Soc., **34** (2): 162. New York, 1926). The types were collected at Vega Alta, and subsequent collections at Bayamón, Toa Alta and Arecibo, from this normal host, and others at Arecibo on grapefruit were identified by Dr. P. W. Oman as being this species.

Dikraneura (Hyloidea) delicata, described by Dr. Osborn (1935–190) from numerous examples at Cayey and a few at Yabucoa, has a "smooth, shining, waxy white appearance, without dots or spots except faint flecks at the tip of elytra in apical cells". "The food plant was not recognized."

Hybla maculata, described by Mr. W. L. McAtee in "A New Neotropical Genus Eupteryginae (Homoptera) from Porto Rico" (Jour. Dept. Agr. P. R., **16** (2): 119–20, fig. 1. San Juan, July 1932) from the leaves of "mamey" (*Mammea americana*) at Barceloneta, others at Pt. Cangrejos, has more recently been found in great abundance, as determined by Dr. J. S. Caldwell, on "emajagua" (*Pariti tiliaceum*) at Cayey, and also on Mona Island.

Typhlocybella minima Baker was collected by Dr. Osborn (1929–106) on Guinea grass at Aguirre and from other grasses at Yabucoa, Río Piedras and Arecibo. It is once recorded on malojillo at Bayamón, and Dr. F. M. Wadley (1937–107) swept it from *Bradburya* at Mayagüez.

Fulgoroidea: Planthoppers

The so-called sugar-cane leafhopper of Hawaii, *Perkinsiella saccharicida* Kirkaldy, which for a time was such a serious pest of sugar-cane there, is, strictly speaking, not a leafhopper at all, but belongs to the family Delphacidae, of the superfamily Fulgoroidea, the members of which, by analogy, should be called planthoppers. As so much intensive study was centered on this one economic pest in Hawaii, naturally the entomologists there became specialists in the Fulgoroidea, and when authoritative

identifications of Puerto Rican planthoppers were desired, the entomologists of the Hawaiian Sugar Producers' Experiment Station could identify the known species, or promptly describe the new forms. Thus, **Parahydriena hyalina**, the type from coffee at Lares, was described by Mr. F. Muir (Proc. Hawaiian Ent. Soc., for 1923, **5** (3): 461–472, pl. 1. Honolulu, 1924) from a single specimen collected by Mr. Francisco Seín. It is by no means abundant, but Dr. H. L. Dozier (1931–14) reports specimens collected at Arecibo and Mayagüez, and Prof. J. A. Ramos has specimens from the Maricao Forest.

Catonia antillicola, described by Dr. H. L. Dozier ("IB" 1936–92) from two specimens collected by Dr. R. T. Cotton at Río Piedras, is known only from the types.

Catonia cinerea, described by Dr. Osborn (1935–195) from two specimens, from Lares and Yabucoa, was subsequently found at several localities on the north coast and on maga at Arecibo, on hibiscus at Mayagüez.

Catonia intricata, described by Uhler from the Island of St. Vincent, was collected from El Yunque by Dr. W. T. M. Forbes, as identified by Dr. Osborn (1935–195).

Bothriocera undata Fabricus, first identified from Puerto Rico by Dr. P. W. Oman, and very similar to *Bothriocera venosa* Fowler of Mexico and Central America, is the most common large representative of the family Cixiidae, characterized, according to Dr. Osborn (1935–196) by being "usually slender,...with elytra or wings hyaline, or slightly clouded, and with a median ocellus at apex of front, just above the base of the clypeus". Its clear, dark-veined wings and body with bluish-grey bloom, "scutellum ferrugineous, with three keels," are quite distinctive, the brown nymphs having warts on head and thorax and long iridescent spicules at caudum. Usually living in a humid environment, it is susceptible to attack by fungi. Mr. J. A. Stevenson in his "Check List of Porto Rican Fungi, and a Host Index" (Jour. Dept. Agr. P. R., **2** (3): 125–264. San Juan, July 1918) records individuals resting on *Palicourea crocea* killed by *Isaria saussurei* Cook, and Miss Vera K. Charles later identified a fungus attacking them as *Hirsutella citriformis* Speare. They ar also caught and eaten by the crested lizard, *Anolis cristatellus*. Sometimes these planthoppers are found on sugar-cane, but that is hardly a normal host, and they are most often noted on the underside of leaves or on the fleshy stems of such rank weeds as *Piper adunctum* and *Heckeria peltata* in coffee groves, and in undisturbed environments along the coast, on wild orange trees, on seagrape (*Coccoloba uwifera*) and in mangrove swamps. They may occur on coffee trees and on coffee shade trees, but preferably on wild trees, such as "laurel sabino" (*Magnolia splendens*) on El Yunque, and "grayumo" (*Didymopanax morototoni*) at Lares. Mr. E. G. Smyth (1919–

146) reports collection on Vieques Island, but no collections have been made on Mona, altho Dr. Osborn implies "an extended distribution in the Neotropics, including the West Indies, Fowler (having) described the species from Guatemala".

Bothriocera bicornis (F.), as identified by Mr. W. L. McAtee, was intercepted on grapefruit at Arecibo and on banana at Mayagüez. It has much darker wings, as shown in the illustration by Mr. R. G. Fennah in "The Fulgoroidea, or Lanternflies of Trinidad, and adjacent Parts of South America" (Proc. U. S. National Museum, **95** (3184): 411–520, pl. 10. Washington, D. C., 1945).

Adult of *Oliarus franciscanus* Stål, twelve times natural size.
(Drawn by G. N. Wolcott.)

Oliarus franciscanus Stål is a somewhat smaller, hardier and more abundant Cixiid at the lower elevations in Puerto Rico, its black body in life having a grey bloom, the five keels on the mesonotum not prominent. Originally described from San Francisco, California, it has a wide distribution thruout the tropics, and, as noted by Dr. Osborn (1929–106) "has received several Latin names due to this wide distribution", among which are *cinereus* Wolcott (1921–18) on sugar-cane in Puerto Rico, and *complectus* Ball, the name given by Dr. P. W. Oman in identifying the specimens collected by Prof. J. A. Ramos on Mona Island. Mr. Francisco Sein, (1929–90) in search for a possible vector of sugar-cane mosaic, found that the nymphs are subterranean, and feed on the roots of sugar-cane and malojillo, thus accounting for the numbers of adults often to be seen on young cane, as well as on other incidental hosts. The somewhat gregarious nymphs are whitish, covered with waxy-white fluff, the surplus of which lines the cavity in the soil where they are feeding on the sugar-cane rootlet.

No apparent injury due to their presence is to be noted in the cane plant, and even when the adults are most abundant, no indication of their feeding on cane leaves can be seen. Accidentally and incidentally, adults have been noted resting on a wide variety of other plants, rarely in the mountains, but everywhere in the coastal regions, including Guánica. Dr. Wetmore found them eaten by the tody (*Todus mexicanus*), and they are so preferred by lizards as to constitute 5% of the food of the grass lizard, *Anolis pulchellus*.

Pintalia alta, described by Dr. Osborn (1935–200) from specimens collected at El Yunque, Lares, Aibonito and Coamo Springs, (but none from Vega Alta or Toa Alta or Trujillo Alto) despite its apparent abundance, has not since been found, and we know nothing of its host relationships.

Pintalia infuscata and **Pintalia maculata** were described by Dr. Osborn (1935–199) from specimens collected on El Yunque, and **Pintalia decorata** Uhler identified by him from a single specimen from Lares.

Myndus obscurus Uhler, as identified by Mr. W. L. McAtee, has been collected from pumpkin at Las Marías, and what may possibly be this species from El Yunque.

Cubana tortriciformis was described by Mr. F. Muir (1924–461) from a single specimen on El Yunque taken at about 3,000 feet elevation, just below the first look-out, at the spring below El Yunque rock. This may possibly be the same as one of this genus collected on hibiscus at Mayagüez.

From light traps run by the U. S. Public Health Service on El Yunque, Mr. J. Maldonado collected specimens identified by Dr. J. S. Caldwell as being a species of **Achilorma** near *fowleriana* (Kirkaldy).

Ladella pallida, originally described as a *Monopsis* from Jamaica by Mr. R. Walker, was first identified from Puerto Rico by Dr. H. L. Dozier, on malojillo at Río Piedras, and subsequently he (1931–14) found specimens that had been collected for the American Museum of Natural History from Mayagüez, Maricao, Aibonito and Coamo Springs.

Ladella acunae Metcalf & Bruner was identified by Dr. Osborn (1935–204) from a single specimen from Coamo Springs.

Tangia (or **Neurotmeta**) **angustata** Uhler is a large, clear-winged, light green Tropiduchid, of which "the green nymphs, with a brush of widely-diverging, transparent-iridescent spicules at caudum, have been reared to adult on coffee". Adults have been noted on various trees in coffee groves, on all the shade trees: *Inga vera*, *Inga laurina* and *Erythrina glauca*, as well as those incidentally present, like wild orange and "jagüey" (*Ficus laevigata*) and on fleshy weeds, such as pokeweed (*Phytolacca decandra*) and "baquiña" (*Heckeria peltata*). Dr. Osborn (1935–206) doubtfully records collection from *Guilandina crista*, from near San Juan. They are much more abundant in the high mountainous coffee groves, as at Indiera, but

did occur in the coffee grove near Río Piedras, before that was cut down to plant in sugar-cane.

Tangia (or **Neurotmeta**) **sponsa** Guérin-Méneville, the common Cuban species, but also rarely found in Puerto Rico, on guava (*Psidium guajava*) at Aibonito, has a less sharply angled vertex than *angulata*.

Tangia (or **Neurotmeta**) **viridis** Walker, a smaller species with vertex rounder but much shorter, is primarily a costal species, having been repeatedly collected on seagrape (*Coccoloba uwifera*) at Loíza and Mameyes, and once on grapefruit at Vega Baja. Rather doubtfully, Dr. Osborn (1935–204) records collections at Aguirre and Salinas, from "mangle de botón" (*Conocarpus erecta*), which appears quite probable as Dr. Luis F. Martorell found one at the lighthouse on Mona Island.

Thionia borinquensis, described by Dr. H. L. Dozier as one of some "New and Interesting West Indian Homoptera" (American Museum Novitates No. 510, pp. 24, fig. 18. New York, December 15, 1931) from specimens collected at Aibonito, is a typical thick-set, short-bodied Issid. Light brown in general color, the nymphs have prominent orange coxae, exceptionally broad bodies and short wings margined in cream, and have been noted in abundance on seagrape (*Coccoloba uwifera*) at Loíza and Mameyes, together with a few adults. It is probable that other species of *Coccoloba* serve as hosts, for interceptions have been made at Cidra and Adjuntas.

Colpoptera brunneus, described by Mr. F. Muir (1924–465) from Utuado, others from Toa Alta and Ciales, is primarily a mountainous species, found in coffee groves, on coffee and on grass and weeds in coffee groves.

Colpoptera carinata, described by Dr. Dozier ("IP" 1936–99) from a great variety of hosts and at localities from Maní beach at Mayagüez to El Yunque, may be distinguished "by the very prominent, humped mesonotum with elevated carinae".

Colpoptera maculata, also described by Dr. Dozier (1931–21) from an equally extensive list of localities, including Mona Island, is more spotted, shining, dark brown; "the most abundant species of *Colpoptera* in Puerto Rico". Judging by the varied hosts to which it is doubtfully assigned, it is a general feeder, most specimens having been "swept from weeds".

Colpoptera maculifrons, described by Mr. F. Muir (1924–466) from Río Piedras, is primarlily a coastal species, found on seagrape (*Coccoloba uwifera*) at Pt. Cangrejos, and in orange groves and "pomarrosa" thickets in the foothills.

Colpoptera flavifrons, described by Dr. Osborn (1935–212) from St. Croix and Antigua, admittedly very similar to *maculifrons*, was found in abundance by Prof. J. A. Ramos (1947–21) on Mona Island.

Neocolpoptera portoricensis, described by Dr. H. L. Dozier (1931–22) from Aibonito, has since been found on "pomarrosa" at Cidra, and on "ausubo" (*Mimusops* or *Manilkara nitida*) at San Lorenzo.

Neocolpoptera monticolens, described by Dr. Dozier (1931–24) from Aibonito, others from Cayey and El Yunque, has since been found on guava (*Psidium guajava*) at Bayamón, and on "laurel sabino" (*Magnolia splendens*) on El Yunque, the young trees planted along the road to the recreation area being heavily infested at times.

In contrast to all these blunt-winged species, **Rhynchopteryx salina,** described by Dr. H. L. Dozier as "A New Fulgorid from Puerto Rico" (Jour. N. Y. Ent. Soc., **35** (1): 53–4, fig. 2. New York, 1927), has wings finely tapering to a point. The type was found on "barilla" (*Batis maritima*) and "cariaquillo" (*Lantana camara*) near the salt ponds west of Guánica, and others at Ponce, Arroyo and Mameyes.

Prof. J. A. Ramos, in his master's thesis on "The Insects of Mona Island, West Indies" (Jour. Agr. U. P. R., **30** (1): 1–74, pl. 2, ref. 45. Río Piedras 1947) proposes and describes the new genus *Paraprosotropis*, closely related to *Prosotropis* Uhler of the family Kinnaridae from the Lesser Antilles, for his yellow, chrome and orange-colored **Paraprosotropis monensis,** the type of which he collected on Mona Island.

Quilessa tristis from El Yunque, **Quilessa fasciata** and **Quilessa pellucida** from the Maricao Forest are other Kinnarids from Puerto Rico, described by Mr. R. G. Fennah (Psyche, **52** (1 & 2): 119–138. Cambridge, May–June 1945), all having been collected by Dr. P. J. Darlington. All except *Quilessa fasciata*, which is mostly yellow or brownish, are "piceous, membrane of abdomen red", which will explain the sad names given these inhabitants of the high tropical rain forests.

Adult of *Acanalonia servillei* Spinola, a Hispaniolan species, not found in Puerto Rico, three times natural size. (Drawn by Fritz Maximilien.)

Acanalonia brevifrons, described by Mr. F. Muir (1924–467) from a single male collected in the Seboruco woods near Laguna San José, has since been found on Mona Island by Prof. J. A. Ramos (1947–20).

Acanalonia coniceps, described by Dr. Osborn (1929–108) from specimens swept from bushes and coarse grasses at Salinas, has the "flattened

margins of the vertex converging to an acute tip". It has since been found on beefwood or Australian pine (*Casuarina equisetifolia*) at El Verde.

Acanalonia viriditerminata (Lethierry), with doubly carinate and even more acute tip, originally from Guadeloupe and Martinique, is reported by Dr. Dozier (1931–13) from El Yunque and Aibonito. All three Acanaloniids have large, broad, opaque green wings, and as found in Puerto Rico are quite rare.

Acanalonia pumila Van Duzee, by comparison with the three large green species, is small and insignificant, but Prof. J. A. Ramos found the greyish adults and nymphs abundant on Mona Island, on the characteristic hairy grey beach plant "té del mar" (*Mallotonia gnaphalodes*). Despite careful and repeated search, it has not been found on this host anywhere in Puerto Rico.

Philatis agilis, originally described as a *Batusa* from Puerto Rico by L. Melichar (Annalen des K. K. Naturhistorischen Hofmuseums, **16:** 192. Berlin, 1901), is doubtfully associated by Dr. Osborn (1935–218) with green individuals, the vertex tinged with reddish brown, from El Yunque and Naguabo.

Chlorochara vivida (Fabricius), also previously noted by Melichar from Puerto Rico, Dr. Osborn (1935–219) identifies with specimens from El Yunque and Mameyes.

Mr. R. G. Fennah in his "Notes on the Flatid Genus *Ormenis* in the British Lesser Antilles and Trinidad, with Descriptions of New Species (Homoptera: Fulgoroidea)" (Proc. Ent. Soc. Washington, **43** (9): 193–210, pl. 2. Washington, D. C., December 29, 1941) compares Puerto Rican specimens of these very common, broad and opaque winged Flatids and finds that the two most often collected: *marginata* and *pygmaea*, are the same, but all are distinct from the many new species which he describes from the smaller islands. This merely confirms Dr. Osborn's quotation (1935–221) from Dr. Oman "that he finds *marginata* and *pygmaea* merge in coloration and that the males have similar genitalia". Adults of both are largely bluish-grey, or light greenish-yellow in color, and sometimes occur in enormous numbers in all parts of the Island, as well as on Mona, especially on seagrape (*Coccoloba uwifera*), "cariaquillo" (*Lantana camara*), coffee trees and jasmin vines. They are well known to anybody with jasmin vines about the house, for they almost invariably infest this plant, shriveling the tender shoots by feeding on them and covering them with a waxy white fluff deposited over the egg-clusters, or surrounding the wingless nymphs. The adults take to flight when disturbed, or with care may be chased around a stem by gentle pursuit with a lead pencil, but the nymphs can be disturbed with difficulty, for their retreat is the surrounding mass of fluff. Spraying with nicotine sulfate, one part in a thousand of water, is

temporarily effective in control, but nothing but repeated spraying will prevent the eventual return of others to your jasmin vines.

Despite their abundance on coffee, no appreciable damage is caused, possibly in part because in the humid environment of the typical coffee grove, many may be killed by entomogenous fungi: *Metarrhizium anisopliae* and *Isaria* sp., as identified by Miss Vera K. Charles. It is on the beach, however, that **Ormenis marginata** Brunnich (= **O. pygmaea** Fabricius) occurs in millions, vast clouds of them flying up from seagrape branches that one may disturb around Isabela and Quebradillas, and especially on the public road from Guajataca down to the beach. Naturally, lizards feed on them, especially the arboreal crested lizard, *Anolis cristatellus*, and even the iguana, *Ameiva exsul*. Dr. Wetmore found that many birds had eaten these little moth-like insects: the tody, hummingbirds, vireos, five warblers, the reinita, the redstart, cliff swallow, flycatcher, pewee, the grasshopper sparrow and even the mozambique. Nymphs of the golden-eyed *Chrysopa* suck the juice from the nymphs, the maggots of the Syrphid fly, *Baccha parvicornis* Loew, and possibly others, are predaceous on the nymphs, but most important of all is the Scelionid wasp, *Phanurus flavus* Dodd, which parasitizes the egg-masses, and is sometimes so abundant that one can with the greatest difficulty find an egg-mass that is not parasitized.

Besides this one common and variable species, Dr. Osborn records (1935–223) finding **Ormenis roscida** Germar, Mr. W. L. McAtee determined a specimen collected on tamarind at Mayagüez as **Ormenis pruinosa** Say, and Mr. F. Muir (1924–469) described from weeds at Vega Baja and coffee at Lares what he named **Ormenis pseudomarginata**. A recently revived generic name for these species is **Petrusa,** or **Petrusina.**

Melormenis antillarum Kirkaldy, in the earlier records from Puerto Rico called *Ormenis quadripunctata* Fabricius, is a brownish species with one large dark brown spot on each wing, beside one more smaller and less obvious. It has been collected on "cucubano" (*Coccoloba laurifolia*) on Mona Island, and on a great variety of hosts, such as "aguacate", coffee, "icaco" (*Chrysobalanus icaco*), castor bean (*Ricinus communis*), "saraguaso" (*Cordia corymbosa*) and "cariaquillo" (*Lantana camara*), at various localities in Puerto Rico, in grapefruit groves and in cane fields, possibly breeding on these plants. Dr. Osborn (1929–109) found it exceptionally abundant on "péndula" (*Cithrarexylum fruticosum*) trees near Salinas. On all of these hosts, and on seagrape (*Coccoloba uwifera*), it does not ordinarily mingle with *Ormensis marginata*, and is usually much less abundant than this common species.

Ormenis infuscata Stål, first identified from Puerto Rico by O. Heidemann, is possibly the darkest, but with the narrow outer margins of its

wings almost white. Nymphs and adults were found on sugar-cane under an aguacate tree by Mr. Thos. H. Jones, but no confirmatory collections on this economic host have since been made. It has been collected on grapefruit at Vega Baja, Vega Alta, Manatí, Arecibo and Añasco, and on guava (*Psidium guajava*) at Arecibo.

The very largest Fulgorid found in Puerto Rico, or at least the one with the largest wings, is the ghostly **Flatoides torttix** Guérin-Méneville, originally described from Cuba; a most striking example of camouflage with outspread, grey or greenish-brown wings, their outer margin wavy, looking like a flake of bark on the trunk of a tree of seagrape (*Coccoloba uvifera*) along the coast, or, more rarely in the mountains, on the trunk of some other smooth-barked tree.

Flatoides punctata (Walker) is somewhat smaller and more bluish-grey, with wings more smoothly margined, but not quite so smooth as in the illustration published by Dr. Osborn (1935–224), who found it on fiddlewood (*Cithrarexylum fruticosum*) at Salinas. Numerous specimens have been collected on Mona Island, some of which were identified by Dr. P. W. Oman, on "cucubano" (*Coccoloba laurifolia*) and other smooth-barked trees of the plateau, as well as attracted to light and on seagrape (*Coccoloba uvifera*) on the beach.

Flatoides angulifera was described by Dr. Osborn (1935–225) from a single, light grey specimen, "probably greenish in life", collected by Dr. Richard T. Cotton on coffee at Aibonito.

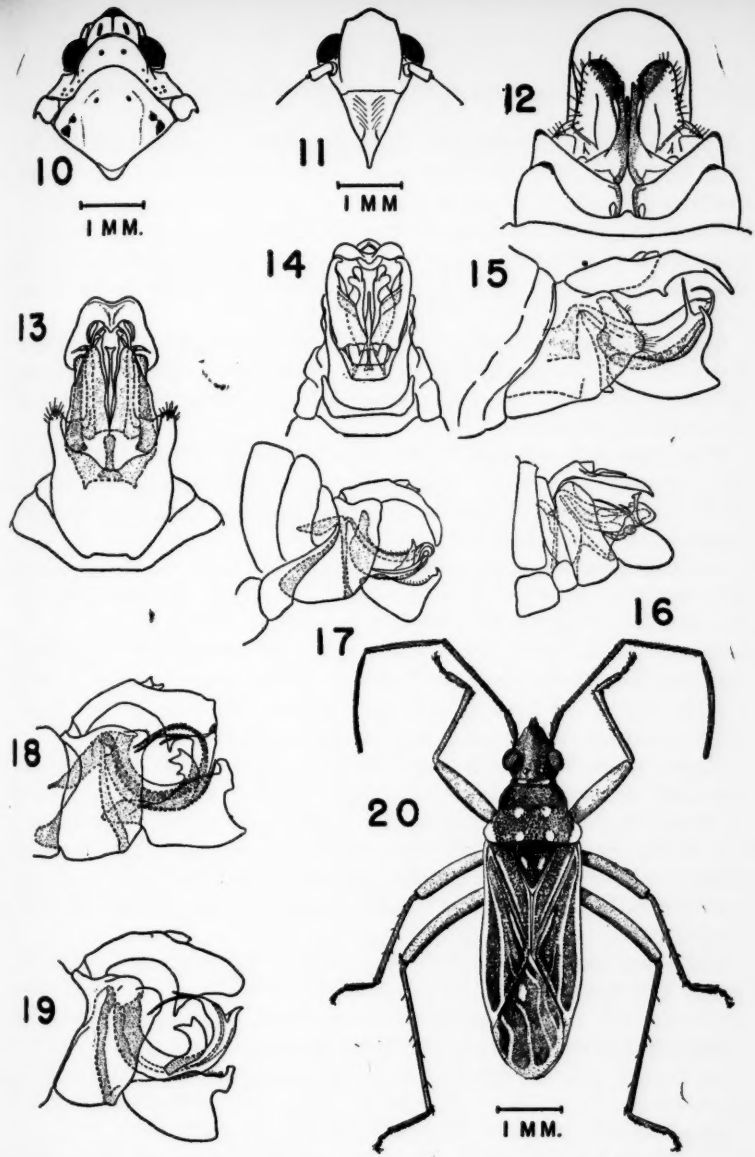
Flatoides brunneus Muir, as determined by Dr. P. W. Oman, has been collected on the coffee shade trees, *Inga vera* and *Inga laurina*, at Mayagüez and at Aibonito.

Flatoidinus fumatus, according to Prof. Ramos, was described from Puerto Rico by Melichar as *Dascalia fumata* in his "Monographie der Acanaloniiden und Flatiden (Homoptera)", the type and a single specimen reported to be in the Signoret collection in the Royal Museum of Vienna.

Rather abundant on "corcho" (*Pisonia albida*) of Mona and on the frangipane or "alhelí" (*Plumeria obtusa*) of the plateau, and also at light on the beach, is a brown and somewhat spotted species, almost entirely lacking in waxy bluish-white bloom, which Prof. J. A. Ramos described on page 19 of his master's thesis "The Insects of Mona Island, West Indies" (Jour. Agr. U. P. R., **30** (1): 1–74, pl. 2, ref. 45. Rio Piedras, 1947) under the name **Flatoidinus pseudopunctatus.**

Mingled with these on the same hosts on Mona Island, one also finds another slightly larger brown species, with four prominent black spots on the posterior margin of the pronotum, suggesting the specific name of **quadripunctatus** and only somewhat less well-marked spots on the wings.

By contrast with these large, broad-winged Flatids, the typical Derbids



Fulgorids from Mona Island: 10, *Flatoidinus pseudopunctatus* Ramos; dorsal view of head and thorax, 11. Frontal view of head, 12. Ventral view of female genitalia, 13. Ventral view of male genitalia, 14. *Melormenis antillarum* Kirkaldy; ventral view of male genitalia, 15. *Flatoidinus pseudopunctatus* Ramos; lateral view of male genitalia, 16. *Colpoptera flavifrons* Osborn; lateral view of male genitalia, 17. *Melormenis antillarum* Kirkaldy; lateral view of male genitalia, 18. *Petrusa marginata* Brunnich; male genitalia of dark form, 19. Male genitalia of pale form, 20. The Lygaeid Bug, *Ozophora octomaculata* Ramos, from Mona Island. (Drawn by J. A. Ramos.)

are slender, delicate Fulgorids. **Cedusa wolcotti,** described by Mr. F. Muir (1924–462) from a large colony on a wild manac palm, *Calyptronoma rivalis* as determined by Mr. José I. Otero, at Indiera, in the mountains north of Yauco, is singularly ethereal and shadowy. This was collected when the new road was being cut thru to Lares, and altho Dr. Osborn could find no vestige of its host when he searched for this species, it has since been found in this region by Prof. J. A. Ramos.

Cedusa santaclara Myers, described from Cuba, first reported from Puerto Rico by Dr. Osborn (1929–107) doubtfully as *C. edentula* Van Duzee and *C. inflata* Ball, has since been collected on "maga" (*Montezuma speciosissima*) at Arecibo.

Phaciocephalus cubanus Myers, reported by Dr. Osborn (1935–229) from Puerto Rico based on a single collection at Añasco, has been found by Prof. J. A. Ramos at Mayagüez, Ponce and at many other localities in the western end of the Island.

Dawnarioides musae, described by Dr. H. L. Dozier as "A New Genus and Species of Derbid from Porto Rico" (American Museum Novitates No. 371, pp. 2, fig. 1. New York, September 26, 1929), swarmed on the under surface of banana leaves at Comerío. Dr. Osborn failed to find this when he was in Puerto Rico, but Prof. J. A. Ramos has found colonies in the typical location on banana leaves at Consumo, between Mayagüez and Maricao, and at Indiera, between Maricao and Yauco.

Patara albida Westwood, a slender white Derbid, with black eyes and antennae, its wings and body faintly marked with brown, has been found on grapefruit at Dorado, on "mamey" (*Mammea americana*) at Barceloneta, on "anona blanca" (*Annona diversifolia*) and on "ausubo" (*Manilkara nitida*) at Río Piedras, on "garcinia" (*Garcinia spicata*) at Mayagüez, and collected in Public Health Service light trap at Ponce by Mr. J. Maldonado Capriles.

Cyklokara sordidulum, described by Mr. J. Muir on p. 416 of his "Homoptera Notes II" (Proc. Hawaiian Ent. Soc., **3** (5): 414–29. Honolulu, 1918) is mostly dull orange-yellow in color, from Aibonito and Mayagüez.

Otiocerus schönherri, described from Puerto Rico by C. Stahl (Berliner Ent. Zeit., **3:** 327. Berlin, 1859), has since been collected at Aibonito, as noted by Mr. Muir (1918–420), and in a Public Health Service light trap at Camp Maravilla, at an elevation of 3,900 feet above Ponce.

Swarms of little Derbids, holding their spotted and whitish opaque wings extended horizontally like those of dragonflies, resting at the base of the coffee shade trees, *Inga vera* and *Inga laurina*, at Río Piedras in August 1923, were described by Mr. Muir (1924–462) as **Dysimia maculata.** Prof. J. A. Ramos has since found them on "garcinia" (*Garcinia spicata*) at

Mayagüez, and they have come to Public Health Service light traps on El Yunque and in the mountains north of Ponce.

Copicerus irroratus Schwarz is possibly the most striking of all the Araeopidae (Delphacinae), "at once recognized by the greatly elongated and foliaceous antennae as shown in the figure" given by Dr. Osborn (1935–235) illustrating the single specimen which he collected at Añasco in 1929.

Stobaera tricarinata Say is known from Puerto Rico from a single specimen collected by Dr. Osborn (1929–110) at Aguirre.

Ugyops granulata is described by Dr. Osborn (1935–236) from a single specimen collected on El Yunque.

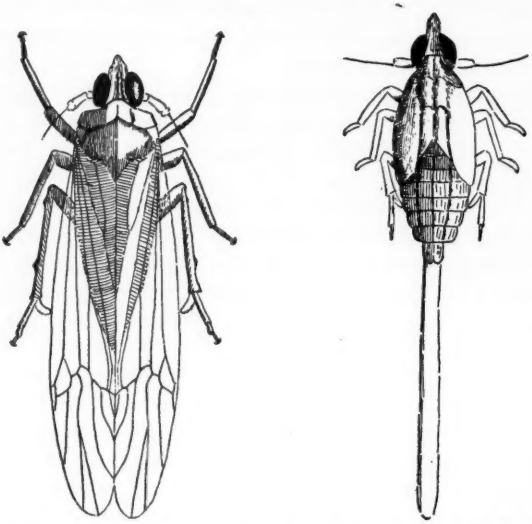
Ugyops occidentalis, described by Mr. Muir (1918–425) from a pair from Aibonito, is considerably smaller and apparently more abundant, as subsequently it has been found on coffee trees and coffee shade trees in the mountains, and on El Yunque. Both species have two distinct carinae on the face, dark or brownish bodies and hyaline, transparent wings.

Punana puertoricensis, thus named by Mr. Muir (1918–425) long before this spelling of the name of the Island was official, was described from collections made at Aibonito, Coamo Springs and Mayagüez. Specimens, as identified by Dr. P. W. Oman, have since been found on guava (*Psidium guajava*) at Aibonito.

Down in the central whorl of young corn plants, mingling with the corn leafhoppers (*Baldulus maidis*), and usually considerably more abundant, are the adults, nymphs and shed skins of **Peregrinus maidis** Ashmead. Their elongate transparent wings are speckled with black and brown; their dark bodies have a broad median stripe of greenish-yellow. Besides the direct injury the feeding of so many small insects may cause to the corn plant, these Araeopids have proved to be the vector of the yellow stripe disease of corn, a virus disease similar to, but quite distinct from the mosaic disease of sugar-cane. Dusting with $1\frac{1}{2}$ per cent of nicotine dust will control them, but in practise the corn plants have such superabundant vigor that they normally survive the heaviest infestations without the need for artificial control. Dr. Richard T. Cotton (1918–291) studied their life-history, and Mr. Francisco Seín suggested the common name: "El Peregrino del Maíz".

Almost the first entomological reference in the history of Barbados is of a black blight of sugar-cane, little understood at the time, which we now know was caused by multitudes of a pale Niagara green Delphacid (Araeopid), **Delphax saccharivora** Westwood, feeding on the cane leaves and excreting a somewhat sticky liquid on those below in such abundance as to furnish a favorable medium for the growth of sooty mold fungi. The

fungi are not pathogenic, but when the black crust on the leaves becomes thick, it shuts off the sunshine from the leaves, and prevents the synthesis of sugar by the cane plant. The insect, in some of the more recent literature discussed under the generic name of *Stenocranus* or *Saccharosydne*, is present thruout the West Indies wherever sugar-cane is grown. It has at various times been a most serious pest in Jamaica and Hispaniola, mass attacks on young plant cane removing so much cell sap from the leaves that the entire shoot withers and dies; the seed piece also being killed eventually



Adult and nymph of *Delphax saccharivora* Westwood, twleve times natural size (Drawn by G. N. Wolcott.)

as each new leaf it puts out is attacked. In Puerto Rico, the insect is present in every cane field, more abundantly in those which receive ample rainfall, but very rarely in any great numbers because of natural parasites which keep its number reduced to a minimum. The eggs are attacked by a Mymarid wasp, *Anagrus armatus* Ashmead, the nymphs and adults by an undetermined Dryinid, and by a Strepsipteran, *Stenocranophilus quadratus* Pierce, the latter being more abundant and killing off more of these Delphacids than all other of its parasites and incidental predators combined. The eggs are deposited in a slit in the cane leaf, which is sealed with some of the whitish fluff from the rear end of the body of the female. The opalescent greenish nymphs feed on the underside of the cane leaves, developing long filaments of white wax, living gregariously and quietly,

with often a few of the active adults still present. While natural control by parasites has always been effective in Puerto Rico, in others of the West Indies, artificial control by dusting with powdered calcium cyanide is very successful and prompt in its action.

Megamelus elongatus Ball, a dirty, straw-colored Araeopid with a very elongate and pointed vertex, has been collected on beach grass at San Juan by Dr. Osborn (1929–110).

Sogata approximata Crawford, as determined by Mr. F. Muir, occurs in malojillo meadows and on grasses in and near cane fields of vegas of the north coast. Dr. P. W. Oman twice identified specimens intercepted on squash.

Sogata aurantii Crawford, as identified by Dr. Osborn (1935–244), was found in February 1912 by Mr. Thos. H. Jones breeding on Guinea grass in considerable numbers, both nymphs and adults being present, attended by the "hormiga brava" (*Solenopsis geminata*).

Adult of *Sogata cubana* Crawford, (= *Megamelus flavolineatus* Muir), twelve times natural size. (Drawn by G. N. Wolcott.)

Sogata cubana Crawford (= *Megamelus flavolineatus* Muir), the "white-lined planthopper of sugar-cane" as Mr. E. G. Smyth (1919–148) called it, is at times quite abundant on sugar-cane, sufficiently so as to form an item in the food of the grass lizard, *Anolis pulchellus*. It occurs in all parts of the Island, Dr. Osborn (1929–111) finding it at Jájome Alto, and collections have been made on beans at Aibonito, on rice at Río Piedras, and on carrots. On young cane it was found in great abundance, averaging one insect per shoot at Garrochales on April 19, 1920, and at Ponce on March 17, 1920, and in lesser numbers at Guayama, Patillas, and at numerous points on the north coast.

Of **Sogata cubana,** Dr. Osborn (1935–243) described a varietal form, **pallida,** swept from grass at Fortuna.

Sogata furcifer Horvath, as determined by Dr. P. W. Oman, has been swept from grass at Bayamón, and found resting on "cariaquillo" (*Lantana camara*) at Loíza. Dr. Osborn (1935–243) collected it at Río Piedras, and Prof. J. A. Ramos on Mona Island.

Sogata parvula Osborn, was collected by Dr. Osborn (1935–245) at Arecibo, and the males described from Puerto Rican specimens.

Liburniella fasciatella, described by Dr. Osborn (1935–246) from Jájome Alto, others from San Juan, swept from grasses, has not since been collected.

The wings of adult Delphacids of the genus **Pissonotus** are very short. From Puerto Rican material Dr. Osborn (1935–247) described **Pissonotus albovenosus,** which has the veination of the wings outlined in white, and **Pissonotus striolus** which has "elytra with areoles fuscous and veins broadly yellowish".

Usually longer wings, but even shorter bodies characterize the eleven species of **Delphacodes** collected from grass in Puerto Rico: most of which were originally described as belonging to the genus *Megamelus* or *Liburnia:* **Delphacodes albolineosa** (Fowler), **andromeda** (Van Duzee), **detecta** (Van Duzee), **havanaensis** (Crawford), **lutulenta** (Van Duzee), **nigripennis** (Crawford), **pellucida** (Fabricius), **propinqua** (Fieber), **puella** (Van Duzee), **humilis** (Van Duzee), **teapae** (Fowler).

The two last have been found considerably more abundant in Puerto Rico than the others, and form a considerable item in the food of the grass lizard, *Anolis pulchellus*, and of *Anolis krugii*. Normally found on pasture grasses and in malojillo meadows, they often occur on young cane and resting on other plants well up into the mountains.

Nilaparvata wolcotti, described by Messrs F. Muir and W. M. Giffard in their "Studies in North American Delphacidae" (Hawaiian Sugar Producers' Expt. Station Bull. No. 15, Entomological Series, pp. 53, pl. 6. Honolulu, January 16, 1924) from a pair from malojillo at Pt. Cangrejos, and a male from sugar-cane at Barceloneta, has since been found on malojillo at Bayamón.

Psylliidae: Jumping Plant Lice

The small, active winged adults of the Psylliidae are the forms least often noted, but the large gall-like pits in leaves, each one of which is occupied by a wax-exuding nymph, are most conspicuous. Indeed, the entomologist most readily identifies the tree called "tortugo amarillo" in Puerto Rico and "caya amarillo" in Santo Domingo (*Sideroxylon foetidissima*) by the deep pits in its leaves caused by the nymphs of **Ceropsylla sideroxyli** Riley, which are almost invariably present on every tree in Puerto Rico and on Mona Island.

Ceropsylla martorelli, described by Dr. John S. Caldwell and named

after the collector, in "New Psyllidae from Puerto Rico, with notes on others (Homoptera)" (Jour. Agr. U. P. R., **26** (2): 28–31, pl. 1. Río Piedras, July 31, 1942) is another species of the same genus, the nymphs of which attack the leaves of "laurel geo-geo" (*Ocotea leucoxylon*). The type is from Aguas Buenas and Cayey, but later collections have been made at Jayuya and in the Maricao Forest, indicating insular distribution in the mountains where the host grows. "The gall is the open pit type with the immature psyllid fully exposed on the under side of the leaf. The adult psyllids are only found during the rainy season when the tree puts out new shoots. Apparently the eggs are laid on the tender foliage and the immatures develop with the leaves."

Arytaina unga was described by Dr. Caldwell (1924–30) from a single female collected by Dr. Herbert Osborn at Mayagüez, of which the "general color (is) dull orange with light stripes on dorsum of thorax and on center of vertex. Antennae annulate with black, two terminal segements black".

Arytaina (or **Euceropsylla**) **cayeyensis,** described by Dr. Caldwell from material collected by Dr. Herbert Osborn at Jájome Alto (above Cayey) on coffee shade trees (*Inga* sp.), has since been found on *Chinchona* spp. in the mountains back of Mayagüez by Messrs. H. K. Plank and H. F. Winters, and also **Euceropsylla russoi** Boselli. Its "general color (is) straw yellow over all with indications of broad white stripes on the thorax; five terminal antennal segments black."

The coffee shade tree *Inga vera* has its tender leaves often infested with another psyllid, identified by Mr. W. L. McAtee in 1922 as **Psylla minuticona** Crawford, a light green species that exactly matches in color the light green leaves on which it exists. **Psyllia martorelli,** described by Dr. John S. Caldwell (Jour. N. Y. Ent. Soc., **52** (4): 335–41. New York, December 1944) from fresh material collected at Villalba on the same host, presumably is the correct name for this misidentified Psylliid. They are so abundant as to be a considerable item in the food of the arboreal lizards of coffee groves: *Anolis gundlachi* and *Anolis evermanni*. The largest ladybeetle found in Puerto Rico, the chestnut-brown *Daulis ferruginea* Olivier, often occurs in association with these Psylliids, and presumably feeds upon them. This ladybeetle, previously found only in the coffee groves of the mountains, has recently been noted in a logwood forest at Guánica, and, on closer examination, it was found that the leaves of logwood (*Haematoxylon campechianum*) were heavily infested with Psylliids, the identity of which is given by Dr. J. S. Caldwell as **Heteropsylla fusca** Crawford.

Heteropsylla puertoricoensis was described by Dr. Caldwell (1942–28) from material collected by Dr. Richard T. Cotton on *Pithecolobium saman*.

Heteropsylla mimosa Crawford, as determined by Mr. W. L. McAtee, infests the "aroma" or "salcilla" (*Acacia* or *Vachellia farnesiana*) of the

south coast. Millions of the minute greenish nymphs and transparent-winged adults occur on the tender shoots, curling and distorting the leaves and causing many of them to fall.

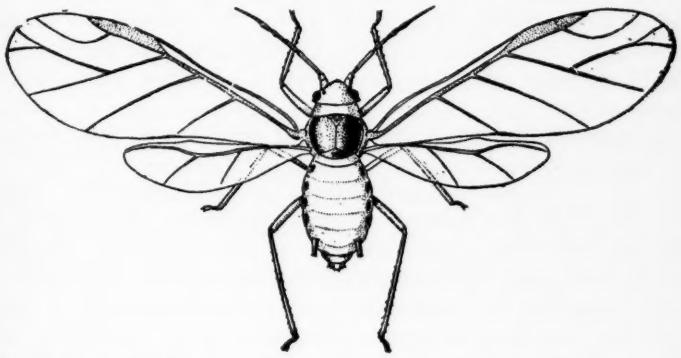
Carsidara concolor Crawford, collected by Dr. Herbert Osborn at Aguirre and at Río Piedras, was identified by Dr. Caldwell (1942–28).

The most mystifying manifestation of any of the Psylliids is the irregular shaped, granular, whitish waxy mass surrounding the nymphal skins of what in 1923 Mr. W. L. McAtee identified as **Euphalerus nidifex** Schwarz, which occur on the leaves of practically every shrub or tree of "ventura" (*Ichthyomethia* or *Piscidia piscipula*), no matter where it may be growing: Cabezas de San Juan, Luquillo, Pt. Cangrejos or Yauco and Boquerón.

Aphididae: Aphids

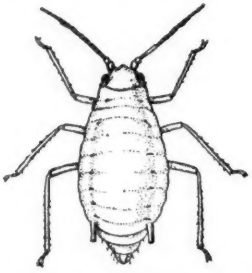
The aphids of Puerto Rico are all cosmopolitan species, not one originally described from specimens collected here. Dr. Stephen A. Forbes, who laid the foundations of economic entomology and scientific and applied ecology in the State of Illinois, described **Sipha flava** from sorghum and broom corn in 1883. In Puerto Rico it is primarily a pest of sugar-cane. Admittedly, the yellow aphid of sugar-cane does occur on sorghum, when that crop is grown in Puerto Rico, but its normal and preferred alternate host is lemon grass (*Cymbopogon citratus*). The introduced Java grass (*Polytrias amaura*) is as subject to yellow aphid infestation as it is to attack by chinch bugs, and the specialists in soil conservation have also found this aphid on *Digitaria sanguinalis* and on a species of *Eragrostis*. On sugar-cane, *Sipha flava* lives in colonies on the underside of the leaves towards the tip. Feeding of the aphids causes the tip to turn yellow and reddish, and eventually brown, from which the colonies gradually migrate down towards the stalk. A heavy infestation causes the entire leaf to dry up, and may even destroy an entire planting of young cane, or, more rarely, even young ratoons. The Uba cane, introduced at the time of the most rapid spread of mosaic disease and resistant to it, is most susceptible to attack by *Sipha flava*, and when the aphids have become very abundant on Uba, they may start new colonies on high cane of other varieties in the neighborhood. Such infestations in high cane may persist for months, being practically impossible to control artificially, and less subject to natural control than if they were on small cane and close to the ground. Aphids have many predaceous and parasitic enemies in Puerto Rico, as elsewhere (see Circ. No. 59, Estación Experimental Insular, Río Piedras, pp. 11, fig. 9. San Juan, 1922) but most of these are also parasitized, and rarely can they be depended upon for effective natural control of major infestations. Nevertheless, they actually do prevent most incipient infestations from becoming serious, as is discovered when applications of DDT have been made to control the aphids.

The DDT is just short of 100% effective in killing the aphids, but it is completely so in killing the parasites and predators of the aphids. Lacking any sort of natural control, the few surviving aphids rapidly increase in numbers, almost equaling the predictions of mathematicians as to their theoretical possibilities. Eventually parasites and predators from adjoining fields, or from the surrounding environment, not all of which has been dusted with DDT, gradually drift in to enjoy an almost unlimited supply of food. As most heavy infestations of *Sipha flava* develop during dry weather, adding the effect of the drought to the feeding of the aphids in stopping the growth of the cane, an extended period of wet weather often proves to be a most effective remedy in control. During such periods of high humidity, the entomogenous fungi, *Acrostalagmus albus* and *A. aphidum*, may destroy every aphid over large areas. Cane growers, impatient in waiting for wet weather, may spray with nicotine sulfate, or dust their cane with cyanogas dust, which gives immediate and almost perfect results directly in proportion to thoroness of application. Since the aphids live on the underside of the leaves, the spray must be directed from below, for it must actually come in contact with the aphids to kill them. Dusting is simpler and more effective, but obviously the dust does not settle up and the great bulk of the application is wasted. When the cane grower guesses right about rainfall, or the effectiveness of natural control in his cane fields, he wins; but if he guesses wrong, the entire planting may be lost due to mass yellow aphid infestation. "The Introduction of Predaceous Beetles into Puerto Rico to aid in the control of the Yellow Aphid, *Sipha flava*" written by Dr. K. A. Bartlett for presentation at the Sixth Congress of International Sugar Cane Technologists, pp. 383–5, at Baton Rouge in 1939, summarizes one other attempt to solve this problem.



Winged female of *Aphis maidis* Fitch. Greatly enlarged. (After Webster.)

Aphis maidis Fitch, the corn leaf aphid, sometimes occurs in large numbers on the husks and tassels of corn. Historically in Puerto Rico, of the greatest importance because of its role in "The Transmission of Sugar-Cane Mosaic by *Aphis maidis* under Field Conditions in Puerto Rico" (Phytopathology, **13** (1): 24–9, fig. 1. January 1923), as shown by the experiments conducted by Carlos E. Chardón and R. A. Veve at Fajardo, its role as vector depends on its presence on weed grasses, such as *Eriochloa subglabra*, in cane fields. Weeding of the grasses causes it to migrate to cane, where it temporarily infests the central shoot. This forced adoption of sugar-cane as a host caused by clean cultivation of the field is an essential factor in the transmission of the disease. Otherwise the aphids would never occur on sugar-cane. Adults soon fly away to more acceptable hosts, but the nymphs continue feeding on the unnatural host of sugar-cane until they also become adult, as was discovered by Mr. Francisco Seín. Sur-

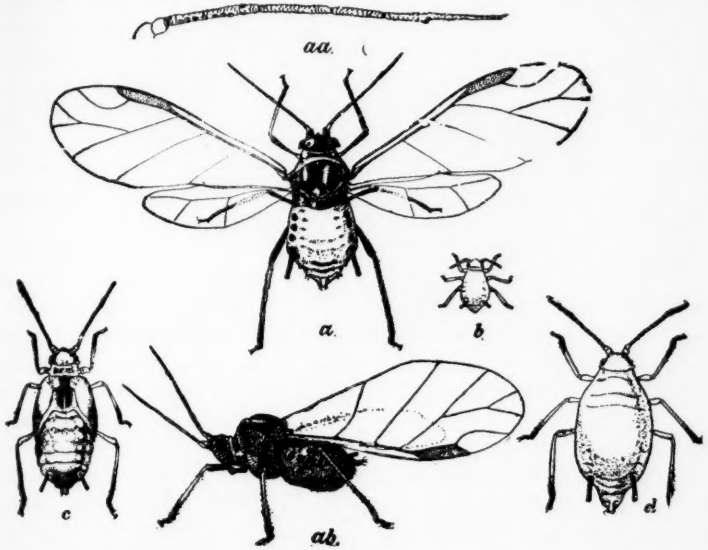


Apterous female of *Aphis maidis* Fitch. Greatly enlarged. (After Webster.)

prisingly enough, these aphids are a preferred food for the little grass lizard, *Anolis pulchellus*, and in the case of seven individual lizards, formed a sixth of the total food. They are also eaten by the crested lizard, *Anolis cristatellus*, but not in such numbers. Possibly this is one reason why one seldom finds many aphids on grass or cane, regardless of their abundance on adjacent corn.

Aphis gossypii Glover is a comparatively minor pest of cotton in Puerto Rico, compared with the injuries it often causes to cucumbers, honey-dew melons, cassava melons and watermelons. Indeed, if these are to produce a crop, it is sometimes necessary to spray repeatedly with nicotine sulfate while the plants are young to give them a chance to grow at all. The aphids cause a tight curling of the leaves while still tender, rendering their control almost impossible unless spraying is started early, before they are protected by the hypertrophy of the plant. The aphids seem to thrive on wind-blown beaches, and under such conditions even continuous spraying seems to have little effect. Repeated plantings of honey-dew melons on the beach

in the Condado were complete failures. An acre of watermelons, planted on Mona Island, produced not a single melon, due to mass infestation by this aphid. Cotton grown close to the ocean at Isabela and Hatillo, just behind the sand dunes, invariably has some aphids on most leaves, but that less exposed to driving winds may be entirely free. On the leaves and flowers of the periwinkle (*Catharanthus roseus*), this aphid causes lesions that superficially look like a mosaic. More or less extensive infestations have also been identified from the tender shoots of guava bushes (*Psidium*



Aphis gossypii Glover: *a*. winged female; *aa*. antenna of same, greatly enlarged; *ab*. dark female from the side; *b*. small nymph; *c*. fully-grown nymph; *d*. wingless female. (After Chittenden.)

guajava), from mangrove (*Rhizophora mangle*), from "María" (*Calophyllum antillanum*), from "roble" (*Tabebuia pallida*), from "almendra" (*Terminalia catappa*), as well as from hibiscus, Pánama potato, tobacco, eggplant and okra. From this long list of possible hosts one should not conclude that most of these plants are often infested, as most of the records refer to only one known occurrence, but in every case, the aphids were definitely identified by Dr. P. W. Mason. Tender leaves of the mango may also be infested, and those of orange at Juana Díaz and of young grapefruit at Añasco are recorded, but these are really exceptional cases. Wet weather sometimes checks incipient outbreaks on melons and cucumbers, for the

aphids are quite susceptible to fungus attack, being hosts for *Cladosporium aphidis* according to Miss Vera K. Charles. They have been found only once in the mountains: on *Cecropia peltata* at Lares. From leaves of *Solanum torvum*, crumpled and distorted by a mosaic, found at Río Piedras

Leaves of melon tightly curled as a result of mass attack by *Aphis gossypii* Glover. (After Chittenden.)

in February 1947, these aphids have been collected, their determination being by Dr. P. W. Mason.

Aphis medicaginis Koch, as identified by Prof. E. O. Essig from material collected at Arecibo, is at times enormously abundant on the underside of the tender leaves of seagrape (*Coccoloba uvifera*). It is however, by no

means so universally present as on the flower stems of "madre de cacao" (*Gliricidia sepium*) each spring, when the blossoms first appear, often causing them to drop without setting seeds. If these host plants were of any particular importance, such universal infestations might seem serious; actually they serve mostly to supply food for a host of Syrphid fly larvae and other predators. This aphid, as identified by Dr. P. W. Mason, has been reported on crotalaria at Mayagüez.

Aphis fabae Scopoli, twice identified under the name *Aphis rumicis* L., on seagrape (*Coccoloba uvifera*) at Ponce, is possibly quite as common on tender leaves as *Aphis medicaginis*, occurring with it, often on the same leaf, but in separate colonies. As the seagrape leaves toughen and harden, the aphids disappear, and neither aphid has been noted on old leaves. The fresh tender leaves of the beach bean (*Canavali maritima*) are also at times heavily infested, and numerous records are of infestations on other leguminous plants, not necessarily on the beach: string beans at Loíza and Manatí, lima beans at Loíza and Vega Baja, and pigeon peas at Río Piedras and Isabela. Mr. H. K. Plank (1943–22) reports heavy infestations on the orange-glow vine (*Senecio confusus*) under the name *Aphis rumicis* L., and it has also been found at Arecibo on *Lantana camara*.

Aphis asclepiadis Fitch, called *Aphis nerii* Fonscolombe in previous records from Puerto Rico, is a large yellow aphid with black antennae and legs, of which infestations often entirely cover the flowering stems and the underside of the more tender leaves of the smaller milkweed (*Asclepias curassavica*) in the more humid parts of Puerto Rico, and of the giant milkweed (*Calotropis procera*) in the dryer regions and on Vieques Island. It is possible that some milkweed plants do occur without these aphids, but they are so universally present that one normally expects to find them on every host. Instances have been noted of such heavy infestations on giant milkweed at Yauco, Ballena and Boquerón that old leaves and mature seedpods were covered with aphids, or their empty skins that had been drained of nourishment by Syrphid fly larvae.

Aphis illinoisensis Shimer, in the earlier Puerto Rican records listed as a *Microsiphum*, or as *Aphis viticola* Thomas, has been found on cultivated grape at Río Piedras, Mayagüez and Ponce, and by Dr. M. D. Leonard on Vieques Island. More rarely, it has been noted on the wild endemic grape or "caro" (*Cissus sicyoides*), not in abundance but with sufficient persistence to serve as a constant source of reinfestation for cultivated grape vines.

The first Puerto Rican record of **Aphis spiraecola** Patch was on grapefruit at Mayagüez, October 23, 1926, when it was intercepted by Mr. S. D. Whitlock. It has since often been noted on grapefruit and especially on wild orange in all the more humid parts of the Island, tightly curling the leaves of watershoots into grotesque rosettes. This early record for Puerto

Rico follows closely on its sudden appearance in Cuba and Florida in 1924 and 1925 as a serious pest in commercial citrus groves, having previously been known only in the northern United States as the green apple aphid.

Aphis spiraecola Patch, as both winged forms and immature stages, was found by Mr. José Adsuar on papaya (*Carica papaya*) in abundance at seven different localities in Puerto Rico in March 1945. Subsequently in the laboratory he was able to prove "The Transmission of Papaya Mosaic by the Green Citrus Aphid, *Aphis spiraecola* Patch" (Technical Paper No. 2, Agr. Expt. Station U. P. R., pp. 5, pl. 1. Río Piedras, June 1946), using these aphids as vectors of the disease. Papaya mosaic is a very different disease from bunchy top, of which Mr. Adsuar found the leafhoppers, *Empoasca papayae* Oman, to be the vector.

Brevicoryne brassicae L., discussed as an *Aphis* as a pest of cabbage by Dr. Richard T. Cotton (1918–283), and **Rhopalosiphum pseudobrassicae** Davis, identified by Dr. P. W. Mason, are found on cabbage, broccoli, mustard and Chinese mustard. The later was noted by Dr. J. A. B. Nolla (1929–66) as host of the entomogenous fungus *Acrostalagmus aphidum.* Both aphids are cosmopolitan species, light green in color, covered with a white bloom. According to Dr. Essig, the latter may be distinguished "by the presence of sensoria on the fourth antennal segment of the winged forms".

Rhopalosiphum subterraneum Mason, as identified by Prof. E. O. Essig, has been found in injurious abundance on the roots of rice at Río Piedras in February 1944, but these purple subterranean aphids had almost disappeared in March, and none was to be found in April.

Rhopalosiphum nymphaeae L., first identified in Puerto Rico by Dr. H. L. Dozier, is a cosmopolitan species occurring on water-lily, and sometimes on other aquatic plants.

Carolinaia cyperi Ainslie, first determined from Puerto Rico by Dr. A. C. Baker, is a greenish-yellow aphid to be found normally only on the underside of the leaves of the common sedge, "coquí" (*Cyperus rotundus*). This sedge, a common weed in cane fields, was present in the field experimental cages used by Chardón and Veve in their transmission experiments of the mosaic disease of sugar-cane, and was therefore included by them (1923–24) as a possible vector of the disease. This aphid, however, does not normally feed on sugar-cane, and Dr. F. M. Wadley (1937–112) thought it of not "much importance in field transmission." Drs. H. Douglas Tate and S. R. Vanderberg subsequently found it to be "as good as *Aphis maidis*" in the "Transmission of Sugarcane Mosaic by Aphids" (Jour. Agr. Research, **59** (1): 73–79. Washington, D. C., July 1, 1939).

Hysteroneura setariae Thomas, as determined by Prof. J. J. Davis, was

called by Mr. Thos. H. Jones (Bulletin No. 11, Insular Experiment Station, pp. 19, pl. 2. San Juan, March 5, 1915) the "brown sugar-cane aphis". It is a purplish-brown species, "not common, occurring in small numbers at the junction of the leaf-sheaths and blades of young cane, covered with sheds of earth built over them by ants, *Solenopsis geminata* Fabr., the 'hormiga brava.'" It has also been noted on the stems, leaves and spike of wire grass (*Eleusine indica*), and Dr. F. M. Wadley (1937–108) records collections on *Gynerium sagittatum* at Guánica, and on *Panicum barbinode* at Rincón, Arecibo and Yabucoa. He found that "the species is much more abundant in dry than in rainy weather", but altho able to transmit the mosaic disease of sugar-cane, of little importance because of scarcity and "at least as numerous in areas of slow spread as in areas of rapid spread."

Toxoptera aurantii Fonscolombe was first reported from Puerto Rico by Mr. R. H. Van Zwaluwenburg (1917–516) as "extremely abundant on new sprouts of coffee, which it occasionally damages severely. Other hosts are orange (which is commonly allowed to grow in a half-wild state amid the coffee) and "geo", an undetermined tree. For two years the writer has witnessed almost complete control of the aphid during the late spring in the mountain plantations by the entomogenous fungus, *Acrostalagmus albus*." In dry weather, when entomogenous fungi are ineffective, these aphids become so abundant as to form an important source of food for the honey creeper or "reinita" (*Coereba portoricensis*). Possibly they are full of honey, for their excretions often attract ants, Dr. M. R. Smith (1937–845 and 954) citing *Crematogaster steinheili* Forel and *Wasmannia auropunctata* Roger, the latter being the infamous "albayalde" of coffee groves. Besides the "geo" mentioned by Van Zwaluwenburg, which presumably is *Ocotea portoricensis*, the tender leaves of numerous other trees are infested: "mantecado" (*Rapanea ferruginea*), "jagua" (*Genipa americana*), cacao and lime in the mountains; and on the coast, seagrape (*Coccoloba uvifera*), "mamey" (*Mammea americana*), "María" (*Calophyllum antillanum*), *Chinchona* spp., mango and grapefruit. It has even been found on the hedge of the post office building in San Juan, when the plant quarantine inspectors had their headquarters there, and eventually managed to intercept from these bushes of "café de la India" (*Murraea* or *Chalcas exotica*) many more insects than casual inspection would indicate could possibly live on them. The tender leaves of grapefruit, orange and mamey are somewhat curled and distorted by the feeding of this aphid, the mamey most of all if infestation occurs when it is less than an inch long. In a colony covering an entire mature and undistorted grapefruit leaf, every aphid had been parasitized by *Aphidius testaceipes* Cresson, but such instances of total parasitism are by no means common.

Curling of the leaves of grapefruit caused by infestation by *Toxoptera aurantii* Fonscolombe, the aphids on the lower leaf being parasitized by *Aphidius testaceipes* Cresson. (Drawn by Francisco Sefn.)

Amphorophora sonchi Oestlund, first identified from Puerto Rico as *Amphorophora lactucae* Kaltenbach by Dr. A. C. Baker from wild lettuce at Adjuntas, also occurs on cultivated lettuce, and is reported by Mr. H. K. Plank (1943–22) on the orange-glow vine, *Senecio confusus* Britton.

Macrosiphum ambrosiae Thomas, as determined by Dr. P. W. Mason, has been found on lettuce at Villalba, and on the branches and leaves of the straw flower (*Helichrysum bracteatum*) there and at Indiera, but it also

occurs close to sea level, for it has been found on gandul pods at Río Piedras, and on "salvia" (*Pluchea purpurascens*) at San Juan and on Mona Island.

Macrosiphum erigeronensis Thomas has been found on dahlia at Guaynabo, and on *Erigeron canadensis* at Dorado, as determined by Dr. P. W. Mason.

Macrosiphum luteum (Buckton), as identified by Miss Louise M. Russell, was found on Cattleya and other cultivated orchids at one point in Pueblo Viejo by Mr. Ferdinand Méndez in November 1949. Originally described from orchids in a greenhouse at Carshalton, Surrey, England, it has since been found in India, and is common in Mexico, Central and South America. In late 1948 this aphid was discovered in Hawaii. It is a large yellow species with black legs, and the apterous form when fully mature typically has a dark dorsal spot. No winged forms have been noted in Puerto Rico, and, so far as known, the aphid has not spread from the locality of original discovery. The outbreak has been controlled with a thoro application of DDT and nicotine sulfate, and as no recent infestations have been observed, it is hoped that the species has been eradicated.

Macrosiphum rudebeckiae Fitch, as determined by Dr. Mason, has been found infesting Ghillardia at Guaynabo.

Macrosiphum solanifolii Ashmead on cultivated peas at Cidra was identified by Dr. P. W. Mason. Lima beans serve as host for **Trifidaphis phaseoli** Passerini at Cidra, for a black-veined aphid, **Picturaphis vignaphilus** Blanchard, and for **Megoura vicae** Buckton, all identified by Dr. P. W. Mason. He considers the aphids from *Dendrobium moschatum* to be a new species of **Megoura,** and has identified those from mint as being **Phorodon menthae** Buckton.

Myzus circumflexus (Buckton) has been collected by Messrs. H. K. Plank and H. F. Winters on *Chinchona* sp. in the mountains back of Mayagüez.

Myzus persicae Sulzer, first reported as a *Rhopalosiphum* from Puerto Rico by Dr. Richard T. Cotton (1918–296) as a serious pest of eggplant and peppers, has also been found on Irish potato, tomato and turnip. Altho killed during wet weather by entomogenous fungi, of which Miss Vera K. Charles lists *Empusa fresenii*, *Cladosporium aphidis* and *Acrostalagmus albus*, during dry weather this aphid may become very abundant in fields of eggplant and pepper being grown for the continental market and prove difficult to control. At Isabela, where these vegetables are grown under irrigation during the sometimes rainless winters, and no aid from entomogenous fungi can be expected, the problem of control is serious, for the parasites and predators so common on other aphids, appear to avoid this

species. In their "Studies on the Mosaic of Peppers (*Capsicum frutescens*) in Puerto Rico" (Jour. Agr. U. P. R., **25** (4): 40–50, fig. 4, ref. 7. Río Piedras, April 7, 1942), Messrs Arturo Roque and José Adsuar state that "evidence of transmission of mosaic by the aphids, *Myzus persicae*, has been obtained". One of the most surprising host relationships of this aphid is of occurrence in large numbers on the green fruits of papaya in 1938 at Isabela, before mosaic disease of this plant had been observed in Puerto Rico. Identification of the material was by Dr. P. W. Mason, as was also that of aphids collected from mosaic plants of "escoba" (*Sida carpinifolia*) at Ponce by Mr. José Adsuar in February 1947. No connection between the mosaics of the various hosts of this aphid has yet been determined.

Pentalonia nigronervosa Cockerell has a very accurately descriptive name by which one will at once recognize this aphid pest of such succulent plants as the banana, yautía, malanga, water-lily and cultivated calla. It may occur in considerable abundance, but hardly in such numbers as to be considered even a minor pest economically. Dr. M. R. Smith (1937–845, 854, 866) notes that it is attended by the ants *Pheidole s. borinquenensis* Wheeler, *Wasmannia auropunctata* Roger and *Brachymyrmex heeri* Forel.

Xenopterygus ipomoiae was described by Mr. Clyde F. Smith as "A New Aphid on Sweet Potato" (Florida Entomologist, **31** (1): 24–26, fig. 1. Gainesville, March 1948), from roots of "*Ipomoia batatas*" (ordinarily written *Ipomoea Batatas* (L.) Lam.), collected by Mr. W. D. Wylie at Clewiston, Florida; others from leaf of dasheen or "yautía malanga" (*Caladium Colocasia* (L.) W. F. Wight), intercepted by Messrs. Richard Faxon, C. G. Anderson and A. S. Mills, December 19, 1932 at Guaynabo, Puerto Rico.

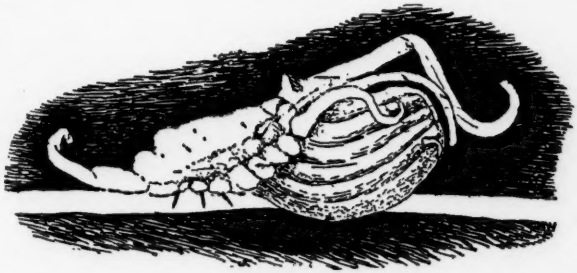
Cerataphis lataniae Boisduval is at once differentiated from any other aphid present in Puerto Rico by the broad white waxy halo which surrounds their round black bodies. The plant quarantine inspectors have repeatedly intercepted this pest on orchids from Venezuela, but it is unquestionably firmly established in Puerto Rico on cultivated vanilla, on various ornamental palms, and especially on the dwarf coconut palms imported from Malaya. Dr. P. W. Mason has identified as a species of **Aleurodaphis** material collected on coconut palm at Mayagüez.

Coccidae: Scale Insects & Mealybugs

Up to the end of the last century, only a single kind of scale insect (Coccidae) was known to exist in Puerto Rico. When the U. S. S. "Fish Hawk" was sent to the Island in January–February 1899, the representative of the Division of Entomology on board, Mr. August Busck, had been instructed to make a special point of collecting scale insects. The "List of the Coccidae collected by Mr. A. Busck in Porto Rico" by T. Pergande

and T. D. A. Cockerell (Bulletin No. 22, n.s., pp. 88–93, Division of Entomology, U. S. Dept. Agr., Washington, D. C., 1900) shows that even at that early period, most of the species now common were already present.

What has fancifully been called the wedding cake scale, **Icerya montserratensis** Riley & Howard (Monophlebinae), was collected by Mr. Busck at that time, on orange at Mayaguez and Bayamón. It has since been found on many other kinds of trees, such as grapefruit, the coffee shade trees (*Inga vera* and *Inga laurina*), "mamey" (*Mammea americana*), guava (*Psidium guajava*), "María" (*Calophyllum antillanum*), "caimito" (*Chrysophyllum argenteum*) and coconut. Possibly the most extensive infestations on record were those on the "laurel de la India" (*Ficus nitida*), growing in the plaza de recreo of Manatí and Caguas. That at Caguas in 1932 was especially severe, most the trees losing their leaves, so that for a time it



Icerya montserratensis Riley & Howard. Five times natural size. (Drawn by G. N. Wolcott.)

seemed doubtful if they would survive. This scale is parasitized by a small yellow Ichneumonid wasp, *Rhyssalus brunneiventris* Ashmead. It really is quite a large wasp, considering that it parasitizes only a scale insect, and that the larva must obtain all its nourishment for complete development to adult from a single scale. The wasp is normally so effective in control that it entirely eliminates most outbreaks at their inception, and all of them eventually, and then most of the wasps perish because they can find no more scales to parasitize.

Icerya purchasi Maskell, the Australian cottony cushion scale, was first noted in Puerto Rico by Dr. W. A. Hoffman (Jour. Ec. Ent., **25** (3): 726. Geneva, June 1932) on trees of beefwood or Australian pine (*Casuarina equisetifolia*) in the patio of the School of Tropical Medicine at Puerta de Tierra, and in hedges in the Condado and Miramar sections of Santurce. Dispersing across San Juan harbor, it became threateningly abundant in Isabela grove and adjoining grapefruit at Palo Seco, but was gradually

brought under commercial control there by means of the introduced Australian ladybeetle, *Rodolia cardinalis* Mulsant, plus various native predators and parasites, some of which, previous to its occurrence in Puerto Rico, are presumed to have fed upon *Icerya montserratensis*. Perfect control was obtained in the citrus groves of the more sheltered Pueblo Viejo district during the hot, rainy summer of 1933 by an entomogenous fungus identified by Miss Vera K. Charles as *Spicaria javanica* Bally. It is so completely effective under suitable conditions of humidity and protection from rapid evaporation of moisture that its total failure to develop close to windswept beaches, as at Dorado and on Mona Island, is all the more noticeable. "The Dispersion of the Cottony Cushion Scale in Puerto Rico in Eight Years" (Caribbean Forester, **2** (3): 132–5, map. New Orleans, April 1941) in the direction of prevailing winds, is shown by the records of outbreaks along the north coast always further west until the northwestern corner of the Island was reached. Each in turn was brought under control by the introduced ladybeetle, reared in captivity and released when and where needed. Infested beefwood seedlings brought from the Río Piedras nursery of the Forest Service carried the scale to Mona Island, where it characteristically threatened to destroy the plantings of casuarinas, until the *Rodolia* beetles were introduced. In the extensive casuarina grove back of Camp Kofresí, cottony cushion scale still continues to exist in varying abundance, forming a reservoir for "Introduced Lady Beetles on Mona Island" (Jour. Ec. Ent., **37** (3): 451. Menasha, 1944) to supply Puerto Rico, if necessary.

The cottony cushion scale does continue to exist in Puerto Rico, but all the various factors of natural control combine to prevent even the most minor of outbreaks, except under exceptional conditions. The most recent ones were of single wild orange trees at Loíza Aldea (1944) and in limes at Palo Seco (1945) and grapefruit at Bayamón (1947): very minor by comparison with those just after its accidental introduction. Sometimes one sees a few scattered individuals on beefwood, and even on rose bushes, but nothing comparable to the mass infestation on these preferred hosts ten years previously. At that time it was also found on "gallego" (*Polysias guilfoylei*), on "Don Tomás" (*Adenoropium multifidum*), on "bayahonda" (*Prosopis juliflora*), on "bucare" (*Erythrina glauca*), on "María" (*Calophyllum antillanum*), on "capa del obispo" (*Acalypha wilkesiana*), on hibiscus, on pigeon pea, on "boisenberry" (a cultivated raspberry) at Isabela and on various other citrus trees besides grapefruit and orange, such as lime and rough lemon.

The dense waxy secretions which make the "cushion" or egg-sac of *Icerya purchasi*, or the ribbons, like those made by a cake-decorator, of

Icerya montserratensis, merely serve to outline the segmentation of the intensely pink bodies of **Crypticerya rosae** (Riley & Howard). First noted on "cambrón" (*Casearia aculeata*) at Ponce, it is quite common on the beefwood trees (*Casuarina equisetifolia*) at El Vigía there, and at Guánica both on the twigs, stem and roots of this host. In the Guánica region, it has been noted on lignum-vitae (*Guaiacum officinale*), and on logwood (*Haematoxylon campechianum*), and Prof. J. A. Ramos found it at Mayagüez on "cereza colorada" (*Malpighia punicifolia*). Almost invariably these mealybug-like scale insects are attended by ants, either the "hormiga brava" (*Solenopsis geminata*), or by the ant more characteristic of this xerophytic region: *Crematogaster steinheili* Forel.

Dr. Alex. Wetmore found in the stomach contents of the ground dove, the ani and the mozambique irregular golden lumps, almost as bright as real gold, but softer and scaling: the protective covering of peculiar scale insects (Margarodinae) called "ground pearls", **Margarodes formicarium** Guilding, which live in the ground, attaching themselves to the roots of plants. Nobody knows just how abundant they really are, for the damage caused to the aerial portions of the host is inappreciable. In sandy land, they may prove a rewarding search for buried treasure, for in three square feet of pasture at Pt. Cangrejos, three ground pearls were found. The iguanas (*Ameiva exsul*) living on the beach, which burrow into the sand for food, and for shelter at night, recognize them as digestible food items, or at least they actually do eat them.

The fleshy stems of the variegated-leaved coleus so extensively planted along roadsides in Puerto Rico when Governor Winship was here, during dry weather are subject to mass infestations of **Orthezia insignis** Browne (Ortheziinae), that sometimes entirely defoliate the plants, and may kill them back to the ground. The insects themselves are black, with exceptionally long and prominent legs (for scale insects), by means of which even the adult females are able to move about slowly. The production of a white waxy secretion begins with the immature stages, and for the adult female results in an elongate quadrangular mass, quite obscuring her black body underneath. Coleus is not the only ornamental infested, for occurrence on rose, rose geranium, begonia and chrysanthemum has been observed, and extensive infestations may develop on the recumbent *Chenopodium ambrosoides*, or on *Lantana camara* or *Eupatorium odoratum*, or similar weeds of the beach or roadside.

When most intensive observations were being made on the insects coming to the flowers of "botoncillo" (*Borreria verticillata*), infestation by this scale was not noted, but twenty years earlier at Pt. Cangrejos, 59 individual scales had been found on a few scattering plants, at that time known under

the name *Mitracarpus* (*Spermacoce*) *portoricensis*, growing in three square feet of sandy pasture. Considering how many alternate hosts exist in Puerto Rico, it is hardly surprising that Governor Winship's project of hiding the tiresome cane fields behind hedges of coleus should have failed so miserably, mostly because of this one scale insect.

Orthezia praelonga Douglas, as identified by Dr. Harold Morrison, has light green or whitish legs and body. In recent years it has become increasingly abundant, on the underside of the leaves of such ornamentals as crotons and "capa del obispo" (*Acalypha wilkesiana*), and bougainvilleas, most often when these plants are planted too close to the house and do not receive the normal amount of rainfall that might help to wash off or beat off scales on plants out in the open. Possibly this is a rather recently introduced insect, for all records except one, on casuarina at Ponce, are from the San Juan region. At Río Piedras, an introduced ladybeetle, *Cladis nitidula* F., has repeatedly been found feeding on these scales. This is a bright yellow beetle, with iridescent green elytra and head, its larvae being white, yellow and black, which seems to specialize in its food habits, if possible confining its attack to these scales, and soon eliminating considerable infestations.

Conchaspis angraeci Cockerell, reported by Mr. R. H. Van Zwaluwenburg (1917–34) as a pest of vanilla at Mayagüez, "not likely to become important" had earlier been found in Puerto Rico on croton at Mameyes and since only on an unidentified tree at Río Piedras.

Dr. Harold Morrison, responsible for almost all recent identifications of scale insect material from Puerto Rico, considers the brown soft scale heavily infesting a coffee shade tree, *Inga vera*, at Maunabo to be a new species of **Lecaniodiaspis.** Despite the abundance of this scale on the trunk and branches of a single tree at the time of collection, December 1937, it was heavily parasited, and has not since been found elsewhere.

The coffee shade tree *Inga vera* is also host of another scale, **Asterolecanium ingae,** described by Miss Louise M. Russell in "A Classification of the Scale Insect Genus *Asterolecanium*" (Misc. Pub. No. 424, pp. 322, many illus. ref. 100. Washington, D. C., November 1941) on page 111, from an abundance of material collected at Utuado by Mr. Vicente Medina.

Mr. Aug. Busck collected what was at that time identified and reported as *Asterolecanium aureum* (Boisduval), now called **A. epidendri** (Bouché), "on leaves of a fiber plant, at San Juan", but nobody has found it since.

The really common species of this genus occur on bamboo: **Asterolecanium bambusae** (Boisduval), **A. militaris** Boisduval var. **robustum** Green, and **A. longum** (Green) (= *A. lanceolatum* Green), the two latter mostly on its leaves, the first on the trunk, all most abundant on *Bambusa*

vulgaris, but also present to some extent on other kinds of bamboo. In an effort to reduce the numbers of these scales, and possibly popularize the use of bamboo in Puerto Rico, Mr. Atherton Lee, while Director of the Federal Experiment Station at Mayagüez, was most active in the importation of ladybeetles to feed upon them. Most of the imported ladybeetles perversely preferred to feed on other kinds of scale insects, and many Puerto Rican peons perversely think that the use of bamboo stamps them as being orientals. Just before election time, when everybody wants to fly his party flag, especially in Cataño, the very tallest and straightest of bamboo poles are at a premium, but until recently this seemed to be the only use of bamboo in Puerto Rico. *Bambusa vulgaris* was at one time extensively planted as windbreaks for citrus groves along the north coast, but most of these have been dug up since the decline of the grapefruit industry, and those remaining have no apparent economic function. *Bambusa tulda* and *Bambusa tuldoides*, but little infested with scale insects when alive, or by powder post beetles when harvested and cured, are increasingly being planted around Mayagüez and Ponce for the manufacture of furniture and fishing-rods.

Asterolecanium pustulans (Cockerell), commonly called the pustule scale because of the hypertrophied plant tissue which grows up like a volcanic crater, or pustule, around it, is a very serious pest on a few preferred hosts. Indeed, to it may be ascribed the practical disappearance of the Australian silver oak (*Grevillea robusta*), after it had been introduced and extensively planted, some twenty years ago. Another imported tree, *Sciacassia siamea*, more especially recommended by the Forest Service because of its rapid growth, is very susceptible to attack by the pustule scale. Even its main trunk, six or eight inches in diameter, may be killed, but fresh watershoots come out from below, perpetuating the tree in a much distorted form to serve as continuous host for the scale. The valuable endemic "maga" (*Montezuma speciosissima*) often has all the leaves of its lateral branches killed by this scale, the injury at a distance looking like fire-blight of pear in the way the dead brown leaves cling to the dead twigs. "Mangle botón" (*Conocarpus erecta*) and Humboldt's willow (*Salix chilensis*) are sometimes heavily infested, but the maximum lesions in depth of pustule and the eruption of a crater around the scale at the bottom of the pit, are on oleander (*Nerium oleander*), especially on young twigs and leaves. Even the fruiting pods of "cañafístula" (*Cassia fistula*) show the deep pits, and the petioles of the leaves of balsa or "guano" (*Ochroma lagopus*). These are the most seriously injured trees; the complete list of all those ever infested in Puerto Rico is long; on Vieques Island, trees of níspero (*Achras zapota*) were killed. Yet despite the seriousness of the

injury which the pustule scale may cause for a time, even the most severe infestations eventually disappear. Except for roughened areas of pits no longer inhabited by scales, no trace of former heavy infestation remains. Such complete elimination of the scale is apparently due to specific parasites, of which Dr. H. L. Dozier has reared and described *Mercetiella reticulata* and *Euaphycus portoricensis*. When infestations are at their peak of intensity, some scales will show the exit holes of these parasites. Later, most of the scales will give this indication of having been killed, and eventually, every scale will be destroyed by the parasites, the perfection of control locally being so complete that no scales are to be found for a number of years on any of the preferred hosts. These two parasites were reared only from the pustule scale, and presumably are endemic in Puerto Rico. The first record of *Asterolecanium pustulans* in Puerto Rico is of collection by Mr. August Busck (1900–92) on *Annona muricata* at San Juan, altho the type was described from Jamaica, on oleander in 1892. Altho now of cosmopolitan distribution in the tropics, it may be endemic in the West Indies and the original, normal and only host of these parasites, which, to date, are known only from Puerto Rico.

Pseudococcus brevipes (Cockerell), a mealybug (Pseudococcinae), is the only obvious major pest of pineapples in Puerto Rico. It is especially abundant in the pineapple fields of the Lajas region, possibly because of the non-commercial varieties grown there, and was enormously abundant on the first Smooth Cayenne planted on Vieques. It is a cosmopolitan pest which may be destructive in any part of the Island but normally is of little importance in the more humid areas. One of the earliest aids to the inexperienced pineapple grower made by the Mayagüez Station was Mr. W. V. Tower's recommendation on the "Control of the Brown Ant (*Solenopsis geminata* Fabr.) and the Mealy Bug (*Pseudococcus citri* Risso) in Pineapple Plantations" (Circ. No. 7, pp. 3. Mayagüez, 1908), by means of spraying with an emulsion of crude carbolic acid, or "cresol" as it is called locally. Until very recently, this was still the most practical method of control of both ants and mealybugs, altho the quality of cresol now available is hardly comparable in efficiency to that when its use was first advocated. Dustin wgith DDT is now being practised. The spraying experiments conducted by Mr. Mario Pérez for the control of "gumosis" indicate most complete elimination of mealybugs when the developing fruits are sprayed at two week intervals with chlordan. In the Lajas region expecially, the use of insecticides is less often necessary because of the establishment of introduced parasites of the mealybug: *Hambletonia pseudococcina* Compere and *Anagrus coccidivorus* Dozier. The sweet syrupy exudations of the mealybug prove attractive to many other kinds of ants than

the "hormiga brava", but this one most often attends it in the open in pineapple plantations. Dr. M. R. Smith, junior author with Mr. H. K. Plank of "A Survey of the Pineapple Mealybug in Puerto Rico and Preliminary Studies of its Control" (Jour. Agr. U. P. R., **24** (2): 49–76, fig. 6, ref. 11. Río Piedras, August 1940) lists fifteen others. On the aerial roots of a "jagüey" (*Ficus laevigata*) at Manatí, this mealybug determined by Prof. G. F. Ferris as *Pseudococcus bromeliae* Bouché, has been observed attended by the hormiguilla. Altho primarily a pest on pineapple, and most abundant on this host normally, this mealybug has also been collected on pomegranate and tamarind, as determined by Dr. Harold Morrison, and, as determined by Prof. Ferris, on the roots of sugarcane at Guánica, and on the roots of the sedge "coquí" (*Cyperus rotundus*) at Guánica.

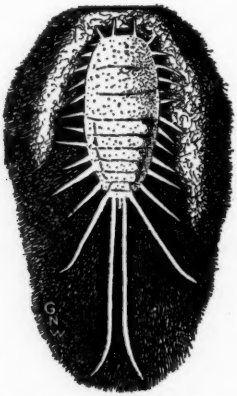
Pseudococcus maritimus (Ehrhorn) has twice been intercepted on pineapple, and once each on tamarind and chayote (*Sechium edule*).

Pseudococcus citri (Risso) quite often does occur on citrus trees in Puerto Rico, but is not of primary importance on this host. From this mealybug Dr. H. L. Dozier has reared four parasitic wasps: *Acerophagus nubilipennis* Dozier, *Leptomastix dactylopii* Howard, *Thysanus nigrus* Ashmead and *Thysanus bifasciatus* Ashmead. Where these wasps can not penetrate, as on the roots of coffee seedlings, it may become a real pest, but as coffee seedlings are handled in practise in transplantation, few mealybugs can survive. It is attended by the hormiguilla on coffee, on both the aerial and subterranean portions of the host, and also in the hormiguilla tunnels. Mr. O. W. Barrett, under the name of *Dactylopius citri*, (1903–445) first noted it as a pest of citrus stock, and considerable infestations have been noted in grapefruit groves at Palo Seco (Isabela Grove) and at Isabela. Individual records on other hosts are on celery, gandul, the roots of a grass, Pánama potato tree at Juncos, on "higuillo" (*Piper adunctum*), guava (*Psidium guajava*) and on "maga" (*Montezuma speciosissima*).

After one kind of yellow mealybug had been found repeatedly in the stomachs of the grass lizard, *Anolis pulchellus*, specimens were sent to Prof. G. F. Ferris, who identified them as **Pseudococcus comstocki** (Kuwana), the only record for the Island.

Pseudococcus adonidum (L.), first recorded by Mr. R. H. Van Zwaluwenburg from Puerto Rico under the name *Pseudococcus longispinus* Targioni as a minor pest of coffee, is most readily observed on the underside of the broad leaves of "almendrota" (*Barringtonia speciosa*), where it seems to be almost invariably present. It has not been observed on this host on Mona Island, however, nor is it known from any other host there. In Puerto Rico it occurs on many other plants. On some elephant ears or "yautía"

(*Xanthosoma* sp.) growing under the eaves of a house in Río Piedras and thus protected from rainfall, it became so abundant as to entirely cover the host, and overflowed on to everything in the neighborhood. On dracaenas and jasmin vines growing too close up under the eaves and protected from rainfall it may also become very abundant. Out in the open, it is a minor pest on grapefruit and hibiscus, and occurs on such trees as "bucare" (*Erythrina glauca*), "María" (*Calophyllum antillanum*) and "emajagua" (*Pariti tiliaceum*), and on the red amaryllis (*Hippeastrum puniceum*). In the summer of 1946 it was first noted on the leaves of the African cloth-bark tree (*Ficus nekbuda*) in Muñoz Rivera Park and around the Capitol building, on which host it eventually became so abundant that by the spring of 1948, large numbers of imported ladybeetles, *Cryptolæmus montrouzieri* Mulsant, were able to develop, feeding exclusively on the



Pseudococcus adonidum (Linnaeus), eight times natural size. (Drawn by G. N. Wolcott.)

mealybugs. The larvae of these ladybeetles are covered with a white waxy secretion, quite similar in general appearance to that of the mealybugs, but when the fully-grown, very active ladybeetle larvae searching for suitable places for pupation can hardly be mistaken for the quiescent mealybugs. From this mealybug Dr. H. L. Dozier reared the wasp parasite which he named *Acerophagus nubilipennis.*

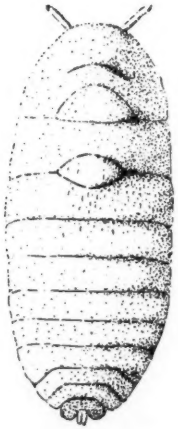
Pseudococcus crotonis (Green) was reported, possibly erroneously, by Mr. E. R. Sasscer ("Important Foreign Insect Pests Collected on Imported Nursery Stock in 1919", Jour. Ec. Ent., **13** (2): pp. 181–4. Concord, April 1920) as intercepted on orchid from Puerto Rico, as it has not since been found here.

Pseudococcus nipae (Maskell) is possibly the most common mealybug

in Puerto Rico. Hardly a guava (*Psidium guajava*) bush on the Island that does not have a few of these mealybugs on its leaves, and often they have heavy infestations attended by "hormiga brava". Mass infestations entirely covering small avocado trees have been noted, and often a few occur on the leaves of such fruit trees as guanábana, coconut, mamey and seagrape. Dr. Luis F. Martorell, when collecting data for his studies on insects of forest trees, found at least a few of these mealybugs on over twenty forest trees, well indicating their lack of pronounced preference for any particular host. The adult female is unmistakable: broad, pink body, with sharply-defined, creamy masses of wax pyramiding from each dorsal division of the body, forming a distinctive shield. During wet weather, it is attacked by entomogenous fungi: *Cephalosporium lecanii*, *Empusa fresenii* and *Botrytis rileyi*, first reported by Dr. Johnston (1915–19 and 21) from Río Piedras. A parasitic wasp, *Pseudaphycus utilis* Timberlake, has been imported for its control, and is reported by Dr. K. A. Bartlett to have become established in the Mayagüez region.

Two kinds of mealybugs are quite common on sugar-cane. **Pseudococcus boninsis** (Kuwana), the bodies of the females of which are grey in color, was referred to under a name not at all suggestive of its economic host, before the studies by Dr. Harold Morrison on the "Identity of the Mealybug Described as *Dactylopius calceolariae* Maskell" (Jour. Agr. Research, **31** (5): 485–500, fig. 6, ref. 16. Washington, D. C., September 1, 1925). The more common species, of which the bodies of the females are pink, is **Trionymus** (or *Pseudococcus*) **sacchari** (Cockerell). For the most part, they live on the stalk of the cane, usually at the nodes under the leaf-sheaths, and it is in part to expose them to readier destruction by natural enemies that the trashing of sugar-cane has at times been recommended. One often finds leafsheaths gnawed away at the nodes, presumably that the mealybugs concealed beneath may be eaten by the animal doing the gnawing. The leafsheaths are thus not only a poor protection for the mealybugs, but are a distinct liability to them during wet weather, when their sweet, watery secretions do not evaporate, but form a suitable medium for the growth of a fungus, *Aspergillus flavus*. This often attacks the mealybugs as well, killing them with an invading growth of mycelium, and soon covering the whole colony with a layer of greenish-yellow spores. The pink mealybug is host to a Cecidomyid fly, *Karschomyia cocci* Felt, and to an introduced Encyrtid wasp, *Pseudaphycus mundus* Gahan, brought from Louisiana in grey mealybugs supposed to be parasitized by *Aphycus terryi* Fullaway, the involved story of which is related by Mr. A. B. Gahan in describing "Eight New Species of Chalcid-Flies of the Genus *Pseudaphycus* Clausen, with a Key to the Species" (Proc. U. S. National Museum, **96** (3200): 311–27. Washington, D. C., 1946). These minute

flies and wasps may be effective enemies of the sugar-cane mealybug, but are not so obvious as the ladybeetles, of which two kinds have been brought into Puerto Rico for their control. *Cryptolaemus montrouzieri* Mulsant will feed on sugar-cane mealybugs in captivity, but is accustomed normally to attack mealybugs not protected as are these, by sugar-cane-leafsheaths, and promptly reverts to unprotected hosts when released in the field. *Hyperaspis trilineata* Mulsant feeds exclusively on sugar-cane mealybugs, and its normal habitat is under leafsheaths, but repeated introductions sent from Barbados by Mr. R. W. E. Tucker have failed (apparently) to establish it in Puerto Rico.



Trionymus sacchari (Cockerell), partly grown female. Twenty times natural size. (Drawn by G. N. Wolcott.)

The grapefruit grove at the Isabela Substation in 1933 became heavily infested with a mealybug secreting a yellowish wax which proved to be **Pseudococcus (Ferrisia) virgatus** (Cockerell), as determined by Dr. Harold Morrison. This is the only record of this mealybug on grapefruit in Puerto Rico, and its occurrence may in part be due to previous spraying of this grove with Bordeaux mixture. At the same time, a heavy infestation by this mealybug was noted in Santurce, on "grocella" or "cereza amarilla" (*Phyllanthus* or *Cicca disticha*). Many of these mealybugs were parasitized by minute yellow wasps with green eyes, identified at the time by Mr. A. B. Gahan as a *Pseudaphycus*. Other trees are infested, as "almendra" (*Terminalia catappa*), "quenepa" (*Melicocca bijuga*) and ornamental croton, the weed "rabo de gato" (*Achyranthes indica*) and lima beans, cotton and okra.

Geococcus coffeae Green, collected by Mr. Francisco Seín, from near roots of ornamental canna at Río Piedras, is reported by Mr. Edson J. Hambleton in his "Studies of Hypogeic Mealybugs" (Rev. de Entomologia, 17 (1–2): 1–77, pl. 7. Rio de Janeiro, August 1946).

Phenacoccus gossypii Townsend & Cockerell, found on cotton at Humacao by Mr. August Busck in 1899, was a new record for the West Indies, and indeed it has been found on this host in Puerto Rico only once since, at Maunabo in 1922, as determined by Prof. G. F. Ferris. A later host record is on "malva" (*Malachra capitata*), but others are of plants botanically quite unrelated, such as tomato and gandul, the ornamental *Acalypha wilkesiana*, on "artemisa" (*Ambrosia peruviana*) and at Faro de Cabo Rojo, "malvavisco" (*Corchorus hirsutus*).

Puto barberi (Cockerell) was identified by Dr. Harold Morrison from material found on an unidentified tree in the Guánica Forest.

Antonina (Chaetococcus) bambusae (Maskell) occurs under the leaf-sheaths of the bamboos growing at Mayagüez.

The body of the female of the soft, greenish-brown scale, **Pulvinaria psidii** Maskell (Coccinae) is pushed off its host by the accumulation of eggs under its body, and the flocculent waxy secretions surrounding the eggs coalesce and completely cover trees heavily infested. Such used to be the condition of "bucares" (*Erythrina glauca*) nearly every dry autumn, the mass infestations of the scales causing an early shedding of the leaves, after which festoons of waxy threads hung from every twig and branch. No such mass infestations are now to be seen. Those reported from Mayagüez by Mr. W. V. Tower (1908–38) on orange and coffee, by Dr. C. W. Hooker on caimito (*Chrysophyllum cainito*), and in Van Zwaluwenburg's list, on orange, mango and zapote (*Achras zapota*), can no longer be duplicated. The present scarcity of this scale on "bucare", and on its other less usual hosts, such as "muñeca" (*Rauwolfia nitida*), "jagüey" (*Ficus laevigata*), "higuillo" (*Ficus sintenisii*), "cedro" (*Cedrela odorata*), "ausubo" (*Manilkara nitida*), crape myrtle (*Lagerstroemia indica*), "péndula" (*Cithrarexylum fruticosum*), "palo de cabrilla" (*Trema lamarckiana*), and guava (*Psidium guajava*), is due almost entirely to the introduction of an Australian ladybeetle, *Cryptolaemus montrouzieri* Mulsant, brought into Puerto Rico for the control of mealybugs of sugar-cane. These ladybeetles had established an enviable record in California, feeding on exposed mealybugs, where they were called "mealybug destroyers". In captivity in Puerto Rico they fed upon the sugar-cane mealybugs provided, but when released in cane fields, they promptly flew out in search for mealybugs or soft scale insects that were more readily available than those under cane leafsheaths. Never again did they return to cane fields, except when "An Outbreak of the Red-Striped Scale", **Pulvinaria iceryi** *Cryptolaemus* (Guérin-Méneville) (=*P. elongata* Newstead), in cane fields near Arecibo, as reported

by Dr. H. L. Dozier (Jour. Dept. Agr. P. R., **9** (4): 357–68, fig. 4. San Juan, October 1925), for once furnished an abundance of preferred food. Subsequent records of this scale are on sugar-cane in greenhouses or in screened cages, where they are protected from attack by parasites and predators.

Pulvinaria urbicola Cockerell, as identified by Dr. Harold Morrison, looks like pinkish lumps on sweet potato tubers, but is greenish-brown on seagrape (*Coccoloba uwifera*), and on "bretaña" (*Basella alba*).

Protopulvinaria longivalvata Green, as identified by Dr. Harold Morrison, is a soft brown scale found on the leaves of gardenia (*Gardenia jasminoides*) at Río Piedras in May 1945. Apparently it is eaten by an introduced ladybeetle from Trinidad, *Cladis nitidula* F., for a few months later, none was to be found on the previously infested bushes. It has since been found on the leaves of *Psidium guajava* at Isabela.

The ant known to coffee growers as "hormiguilla", *Myrmelachista ramulorum* Wheeler, in its tunnels in coffee and coffee shade trees cares for and collects the sweetish excretions from the common mealybug *Pseudococcus citri* (Risso), but in addition it has a specific symbiotic shapeless pink scale insect. For many years after its discovery by Mr. W. V. Tower (1911–32), mention by Dr. C. W. Hooker (1913–35) and more extended discussion by Mr. R. H. Van Zwaluwenburg (1917–515), it remained unnamed. Prof. G. F. Ferris described it under the name of *Cryptostigma ingae*, the type from *Inga laurina* at Lares (Canadian Entomologist, **44** (7): 160–1, fig. 4. Orilla, July 1922), and Dr. Harold Morrison described it under the name *Akermes secretus*, the type from *Inga laurina* at Mayagüez (Psyche, **29** (4): 145–8, fig. 20–31. Cambridge, August 1922), the actual date of publication of Dr. Morrison's name antedating that of Prof. Ferris' by a few days. The correct name for this distended, pink "cow" of the hormiguilla should be **Cryptostigma secretus** (Morrison). So far as known, it occurs only in Puerto Rico, but invariably associated with the hormiguilla, not only in its tunnels in coffee and coffee shade trees, but also in its tunnels in "jagüey" (*Ficus laevigata*) at Manatí, and in "pomarrosa" (*Eugenia jambos*) at Adjuntas. The mealybug found with the hormiguilla in cavities in twigs eaten out of solitary trees of "tortugo amarillo" (*Sideroxylon foetidissimum*) at Isabela was determined by Dr. Morrison as being "a species of *Pseudococcus*, but I have not succeeded in placing this as any described species." Of these three symbiots, apparently *Cryptostigma secretus* is the more efficient from the standpoint of the ants, or at least none of its energy is diverted to the production of wax, for it is entirely naked: merely and solely a digestive machine for extracting sap from the host and passing it on to the ants on demand, but also absolutely dependent on them for protection and care.

The wax, closely compressed, and typically molded into an opaque, amorphous shield, but sometimes divided into distinct, sharply segregated plates, is all that one sees from above of the wax scales. On Mona Island, an especially large *Ceroplastes* has been found on the petioles of seagrape (*Coccoloba uvifera*) leaves.

Ceroplastes floridensis Comstock was collected in 1899 by Mr. August Busck, on *Annona reticulata*, altho in Florida as well as in Puerto Rico, its typical host is citrus, on which it was noted by Mr. O. W. Barrett (1903–445) and by Mr. W. V. Tower (1908–38) at Mayagüez. To these records, Mr. R. H. Van Zwaluwenburg adds mango, sweet potato and guava (*Psidium guajava*). It has since been found on coconut, banana, avocado (*Persea gratissima*), "jagua" (*Genipa americana*), "bádula" (*Rapanea guianensis*), "mangle" (*Laguncularia racemosa*), "jagüey" (*Ficus laevigata*), "laurel de la India" (*Ficus nitida*), and repeatedly on grapefruit. Despite the number of records on orange and grapefruit, it is distinctly not a pest, but merely an interesting inhabitant, rarely noted by the commercial grower.

Ceroplastes cirripediformis Comstock, collected and identified by Dr. H. L. Dozier on a *Ficus* and Passion flower vine at Bayamón (1925–366) as host for *Aneristus ceroplastae* Howard, and on lignum-vitae (1927–274) as host for *Plagiomerus cyanea* Ashmead, was earlier found on *Myrcia paniculata* at Algarrobo, and since on "cedro" (*Cedrela odorata*) at Cayey, on "palo de muñeca" (*Rauwolfia tetraphylla*) at Guayama, on *Chinchona* at Mayagüez.

Ceroplastes ceriferus (Anderson), collected by Mr. D. L. Van Dine on "almácigo" (*Elaphrium simaruba*) at Guánica in 1911, has been found only once since, on *Sauvagesia erecta* at Naguabo.

Ceroplastes cistudiformis Townsend and Cockerell is listed by Mr. R. H. Van Zwaluwenburg on *Euphorbia robusta* and on *Ipomoea fastigata*.

The intrinsic beauty of the African cloth bark trees, *Ficus nekbuda*, first planted in Muñoz Rivera Park, Puerta de Tierra, was flawed by the coating of sooty mold that soon darkened every leaf. This black fungus grows on the excretions of **Ceroplastes denudatus** Cockerell, a wax scale not known to exist in Puerto Rico before these trees had been imported, and presumably brought in with them. This is not the only host on which the scale can exist, however, for coconuts growing near the cloth bark trees have also become infested with this wax scale. At Camp Buchanan, the ornamental edging plant, "jamón con huevo" (*Achyranthes bettzickiana*), was so heavily infested that partial defoliation resulted. Most recently it has been found on lignum-vitae (*Guaiacum officinale*) at Guánica, and in the meantime has quite disappeared from the cloth bark trees in Muñoz Rivera Park, where it was formerly so abundant.

Vinsonia stellifera (Westwood) is unlike any other Puerto Rican scale insect in appearance, for its waxy covering naturally develops into a four, five or six pointed star. In Puerto Rico, Mr. August Busck first collected it on the fronds of the coconut, which is still a common host, on which it may almost invariably be found, at least in small numbers. It also occurs on other hosts, Mr. O. W. Barrett (1903–446) mentioning "pomarrosa" (*Eugenia jambos*), and Mr. R. H. Van Zwaluwenburg listing mango, guava (*Psidium guajava*), sisal (*Agave sisalana*) and Manila hemp (*Musa textilis*). It has repeatedly been collected on the mangosteen (*Garcinia mangostana*), and on such botanically unrelated hosts as orchid leaves, "guinda" (*Arthurium scandens*), "resedá" (*Lawsonia inermis*), "cucubano" (*Coccoloba laurifolia*) and "mamey zapote" (*Achras zapota*) on Vieques Island. Despite the number of records, it is not really abundant, and is of negligible economic importance. On mango leaves it has been found killed by the entomogenous fungus *Aschersonia cubensis* B. & C., as determined by Miss Vera K. Charles, who also records it as host for *Aschersonia turbinata*.

Inglisia vitrae Cockerell has been collected in Puerto Rico on pigeon peas, on "achiote" (*Bixa orellana*), and on the coffee shade tree *Inga vera*.

Eucalymnatus tessellatus Signoret was first identified from Puerto Rico on mango by Mr. G. B. Merrill, and by Dr. E. W. Berger, reporting on "Natural Enemies of Scale Insects and Whiteflies in Florida" (Quarterly Bulletin Florida State Plant Board, **5** (3): 141–154, fig. 10. Gainesville, April 1921), as killed by the entomogenous fungus *Aschersonia cubensis*. It was collected by Dr. H. L. Dozier on "María" (*Calophyllum antillanum*), which is its most common host in the mountains, and found to be the host of the parasitic wasp *Aneristus ceroplastae* Howard. Dr. Harold Morrison identified it from "tortugo amarillo" (*Sideroxylon foetidissimum*) on Mona Island, and from Malay apple (*Jambos malaccensis*) at Trujillo Alto.

The leaves of the hedge of Malay apple (*Jambos malaccensis*) at Trujillo Alto are also infested with a soft green scale, **Coccus acuminatus** (Signoret), as identified by Dr. Harold Morrison. It has been found on the leaves of "achiote" (*Bixa orellana*) at Salinas, and of "dormidera" (*Emelista tora*) at Barceloneta. These are only minor and incidental hosts, however, for this scale is normally so abundant on the leaves of "pomarrosa" (*Eugenia jambos*) that all its older leaves are blackened with the sooty mold growing on its excrement. At a distance, thickets of pomarrosa appear almost black, and invariably much darker than other trees growing in the same region. Miss Vera K. Charles records this scale attacked by the entomogenous fungus *Hypocrella caulium*.

Coccus hesperidum (Linnaeus) is considered by Dr. H. L. Dozier (1926–118) to be no more abundant in Puerto Rico because of its being heavily parasitized by the wasp *Coccophagus lunulatus* Howard. This soft scale has been collected on "maguey" (*Agave americana*) at Río

Piedras and Trujillo Alto, on "grosella" (*Phyllanthus distichus*), on banana at Arecibo, and on "buenas tardes" (*Hibiscus bifurcatus*) at Vega Alta. A colony on the underside of papaya leaves at Guánica was partially covered with a carton shelter built by the ant *Crematogaster steinheili* Forel, and it has also been found on this host at Río Piedras and Luquillo by Mr. Francisco Seín, but attended by the "hormiga brava," *Solenopsis geminata*.

The tender unfolding leaves of the mango are pink or reddish when they first develop, but soon turn a light green that darkens as they become hard and mature. Seen from a distance, however, the foliage of mango trees is much darker, tending to be almost black. This is due to a film of sooty mold with which practically every old leaf is covered, a sooty mold similar to that on other trees infested with honey-dew secreting insects. On mango this is a soft green scale, **Coccus mangiferae** (Green), which at times also occurs on the leaves of "pomarrosa" (*Eugenia jambos*), "palo de pan" (*Artocarpus communis*), "seso vegetal" (*Blighia sapida*) and a "laurel" (*Nectandra sintenisii*). Dr. Harold Morrison points out that "the deltoid shape, but without the fringes of secretion, and the elongated anal plates with outer angles near apices, should serve to make this recognizable where it is found on mango". To some extent it is controlled by entomogenous fungi, Dr. J. R. Johnston (1915–19) mentioning *Cephalosporium lecanii*, Mr. J. A. Stevenson (1918–207) listing *Botrytis rileyi*, and Miss Vera K. Charles, *Hypocrella* (*Aschersonia*) *turbinata*.

These fungi, especially the first, are also responsible for the economic control of "The Green Scale, **Coccus viridis** (Green), a New Pest in Coffee and Citrus" (Agr. Notes No. 48, Agr. Exp. Station, Mayagüez, pp. 2., July 1929), which, when reported by Messrs. T. B. McClelland and C. M. Tucker, had first appeared as a serious pest of coffee at Villalba in 1927. From Villalba it had rapidly spread to coffee groves in all parts of the Island, later attacking grapefruit, lime and guava bushes (*Psidium guajava*) along the coast. In coffee groves, its sweetish secretions proved especially attractive to the "albayalde", but it was also in humid coffee groves that control by entomogenous fungi most nearly attained total effectiveness. As a new pest, it attacked the Meyer lemon (*Citrus excelsa* var. *davaoensis*) trees at Isabela Substation in such numbers as to threaten their very existence. In later years, commercial oil sprays on grapefruit, plus natural control in coffee groves changed the status of *Coccus viridis* to merely that of one more minor pest. Many forest trees also serve as host to a minor extent, possibly the most interesting being "tortugo amarillo" (*Sideroxylon foetidissimum*), of which infested leaves have been found at Guánica and on Mona Island. Messrs. H. K. Plank and H. F. Winters found it attacking *Chinchona* spp. in the mountains back of Mayagüez.

Saissetia hemisphaerica (Targioni), the hemispherical scale, is one of the most common and certainly one of the most conspicuous of scale insects. The adult females are shining, chestnut-colored hemispheres, often so abundant as to entirely cover infested twigs. They are so obvious that even lizards eat them, and Dr. Alex. Wetmore found them in the stomachs of the tody, the parula warbler, the oriole, the tanager and the mozambique. The "hormiga brava" (*Solenopsis geminata* F.) is almost invariably associated with mass infestations of the hemispherical scale, collecting its excretions so promptly that rarely does enough fall on surrounding leaves to develop a suitable medium for the growth of sooty molds. Despite what seems to us such powerful protection against most enemies, at least two parasitic wasps have been reared from it: Dr. H. L. Dozier (1925–367) reporting *Aneristus ceroplastae* Howard, and Dr. M. R. Smith (1942–23) *Encyrtus infelix* Embleton. In a humid environment, such as a coffee grove, the hemispherical scale may be completely wiped out by

Colony of *Saissetia hemisphaerica* (Targioni) on stem of balsam, four times natural size. (Original.)

Cephalosporium lecanii, with the margins of each dead scale outlined with white mycelium on the host. Miss Vera K. Charles (1941–710 and 762) also lists *Torrubiella lecanii* and *Aschersonia cubensis* as entomogenous fungi attacking the hemispherical scale.

Every host of *Coccus viridis*, and many others, including cotton, okra and many vegetables, mistletoe, the cycad *Zamia latifoliata*, the sago palm *Cycas revoluta*, and many fruit and forest trees, including chinchona, are subject to attack by the hemispherical scale. On Mona Island it has been noted on eggplant, "almendra" (*Terminalia catappa*), seagrape (*Coccoloba uwifera*), "cucubano" (*Coccoloba laurifolia*) and "tortugo amarillo" (*Sideroxylon foetidissimum*).

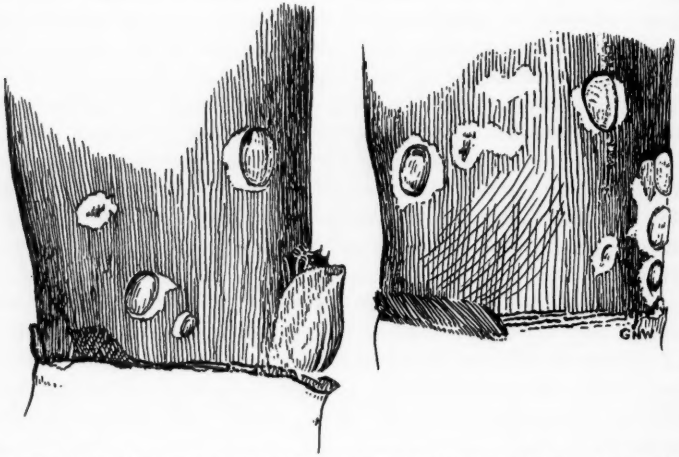
Saissetia oleae (Bernard), in California called the black scale, is considered by California citrus growers their most serious pest, according to Prof. E. O. Essig, "being responsible for losses of more than two million dollars to fruit growers in California alone". In Puerto Rico it can hardly be considered an economic pest at all. Altho it sometimes does occur on citrus and some forest trees, mass infestations are usually on

"almendra" (*Terminalia catappa*), on which it was first noted in Puerto Rico by Mr. August Busck, and on which it is common on Mona Island, as well as here. Mr. R. H. Van Zwaluwenburg lists in addition, orange, oleander (*Nerium oleander*), "guácima" (*Guazuma ulmifolia*), "bucare" (*Erythrina micropteryx*) and wild eggplant (*Solanum torvum*), and Dr. M. D. Leonard (1933–118) mahogany (*Swietenia mahagoni*) and *Vitex altissima*. When the African tulip tree (*Spathodea campanulata*) was first introduced into Puerto Rico, it was often infested, and it still is susceptible to attack. After it has finished blooming, poinsettia is often attacked. Both *Ficus nitida* and *Ficus laevigata* sometimes serve as hosts, and the specific identity of material from a mass infestation on *Ficus stahlii* at Ponce, sent to California for comparison with California specimens, was confirmed by Dr. Ralph H. Smith. Dr. Luis F. Martorell, collecting records on forest trees, found that most economic or common species were infested to a greater or less extent. *Lecanobius cockerelli* Ashmead and *Eupelmus saissetiae* Silvestri are the parasites which Dr. H. L. Dozier reared from this scale, and it is of sufficient size when fully grown so that females are eaten by the crested lizard. Black scale is a rather unfortunate name for this insect, as even the oldest and darkest females are not black, the immature females being much lighter in color, and distinguished by two transverse and one longitudinal ridge across the back which forms a very distinct and conspicuous letter "H".

Saissetia nigra (Nietner) really is black, an unwrinkled shining black, or at least such a dark brown as to seem black by comparison with other scale insects. Mr. Busck collected it on cotton and almendra, these still being common hosts, as well as other malvaceous plants, such as "maga" (*Montezuma speciosissima*), "emajagüilla" (*Thespesia populnea*) and "cadillo" (*Pavonia typhalaea*); the introduced California pepper tree (*Schinus molle*), chinaberry or "lilaila" (*Melia azedarach*), and mistletoe. From scales of this species sent to California, Dr. Stanley E. Flanders reared the following parasites and predators: *Scutellista cyanea* Motsch., *Eupelmus coccidivorus* Gahan, *Lecanobius cockerelli* Ashmead, *Coccophagus scutellaris* Dahm., *Aneristus ceroplastae* Howard, *Marietta* sp. and *Scymnus flavifrons* Melsheimer. Miss Vera K. Charles (1941–717) records this scale as host of the entomogenous fungus *Cephalosporium lecanii*.

Very different in its habits and appearance from the other Coccinae is **Aclerda sacchari,** described by M. M. Teague (Ann. Ent. Soc. America, 18 (4): 433–441, pl. 3. Columbus, December 1925), the type from sugarcane stalks and root-stalks at Guánica. The purplish-grey, oval young, flattened between leaf-sheath and root-stalk, develop into what look like fully-engorged ticks, but dark brown and fragile, surrounded by a halo of white wax. Recorded first from Puerto Rico under the incorrect name of

Aclerda tokionis Cockerell, they are so scarce as to be of no economic importance, but nevertheless something for which to search if one is to know every insect infesting sugar-cane in Puerto Rico.



Aclerda sacchari Teague, on stalks of sugar-cane, twice natural size. (Original.)

The excess carbohydrates in the cell sap of the plant on which the scale insect feeds, for which its sedentary mode of life finds no use, may be excreted as a sweet syrupy liquid which attracts ants, or fall on surrounding vegetation and be a culture medium for the growth of sooty mold fungi. Or it may be eliminated as filaments of wax, to cover the eggs, or forming a halo around the insect, or in the case of the wax scales as soft amorphous wax to cover the insect. The armored scales (Diaspinae) secrete a somewhat different type of wax or gum, which hardens on their backs to form a much harder, tougher and more resistant covering, a veritable armor for the insect underneath. The females of the so-called white scale of citrus, *Chionaspis citri* Comstock, now called **Unaspis citri** (Comstock), are not white at all, but of the uncertain dull hues, dark grey or reddish-brown, of their armored covering. The very accurately descriptive name for this scale is derived from the males, which are white in color, oblong in shape, with three parallel longitudinal ridges, the head end being somewhat constricted in a small bright yellow area. They are often much more abundant than the females, and naturally much more conspicuous against the dark bark of the citrus tree. Normally, the white scale occurs mostly on the trunk of the tree, but is also to be found on twigs, leaves and fruit. Mr. August Busck collected it on lime at Añasco, but it is common on

orange and grapefruit, being, after the equally host-restricted purple scale, *Lepidosaphes beckii* (Newman), the most injurious scale insect pest of the citrus groves of Puerto Rico. From it, Dr. H. L. Dozier reared no internal parasite, and it is not fed upon by any endemic ladybeetle, but the introduced *Chilocorus cacti* is often seen in citrus groves, presumably feeding on this and other scales present. In the more humid groves, protected from the action of the wind by surrounding hills or windbreaks of bamboo or the remnants of virgin forest, entomogenous fungi may be an important factor in control. Mr. John A. Stevenson in his "Check List of Porto Rican Fungi and a Host Index" (Jour. Dept. Agr. P. R., **2** (3): 125–264. San Juan, July 1918) lists *Myriangium duriaei*, *Septobasidium spongium* and *Tubercularia coccicola*, the latter being listed as a *Podonectria* by Miss Vera K. Charles in her "Preliminary Check List of the Entomogenous Fungi of North America" (Insect Pest Survey Bulletin, **21** (Supplement to No. 9): 707–785. Washington, D. C., November 10, 1941) in addition to its imperfect stage as a *Tetracrium*.

From the grass "burrillo" (*Sporobolus berteroanus*) growing on the beach at Arecibo in May 1921, an abundance of material was collected which Dr. Harold Morrison tentatively identified as *Chionaspis* "near *spartinae*", and subsequently placed as **Chionaspis distichlii** Ferris with the notation "differing in several small details".

Howardia biclavis (Comstock) was first collected in Puerto Rico by Mr. August Busck on "achiote" (*Bixa orellana*), and has repeatedly been found on this host since. Dr. C. W. Hooker reports it on "mamey zapote" (*Achras zapota*), on "mamey" (*Mammea americana*), on "manzana cafre" (*Doryallis caffra*) and on coffee, to which Mr. R. H. Van Zwaluwenburg adds "alhelí" (*Plumiera rubra*) and Mr. H. K. Plank, chinchona. Dr. H. L. Dozier (1927–273) from material on the ornamental *Acalypha wilkesiana* reared the parasitic wasp *Pseudopteroptrix imitatrix* Fullaway and Mr. J. A. Stevenson (1918–134) lists it as host of the entomogenous fungus *Myrangium duriaei*. In addition to the hosts mentioned, it has been found on "caimito" (*Chrysophyllum cainito*), "algarrobo" (*Hymenaea courbaril*), "jagua" (*Genipa americana*), "roble" (*Tabebuia pallida*), "guara" (*Cupania triquetra*), "cedro" (*Cedrela odorata*), "madre de cacao" (*Gliricidia sepium*), oleander (*Nerium oleander*), "hoja menuda" (*Myrcia citrifolia*), "guía verde" (*Casearia arborea*), "serrasuela" (*Guettarda scabra*), "malvavisco" (*Waltheria americana*), beefwood (*Casuarina equisetifolia*), rubber tree (*Castilla elastica*) and the ornamental *Monstera deliciosa*.

Diaspis boisduvalli Signoret is a serious pest for the orchid grower, but except on orchids, has been found in Puerto Rico only on Malay apple (*Jambos malaccensis*).

Diaspis bromeliae (Kern), a grey or whitish scale often seen on pine-

apples near the base of the leaves or scales, is not noticeably injurious, and has been found on no other host in Puerto Rico.

Diaspis echinocacti (Bouché) is equally common on cacti. It was first collected in Puerto Rico by Mr. August Busck, who listed it as *Diaspis calyptroides* Costa var. *opuntiae* Cockerell, and has been noted many times since, but only on cacti.

Lepidosaphes beckii (Newman), the purple or oyster-shell scale, as normally infests the twigs, leaves and fruit of citrus trees in Puerto Rico as the white scale does their trunks. The two together constituted the main reason why citrus trees must be sprayed with oil sprays if they were to produce a crop of fruit. During wet weather, and more especially in groves protected against the drying action of wind by hills or windbreaks, the entomogenous fungi might effect commercial control, and certainly the list of fungi attacking the purple scale is very impressive. Those listed by Dr. John R. Johnston, Mr. J. A. Stevenson and Miss Vera K. Charles from Puerto Rico are: *Aschersonia turbinata*, *Scoleconectria coccicola*, *Sphaerostilbe aurantiicola* (= *S. coccophila*), *Septobasidium spongium*, *Myrangium duriaei*, *Microcera fujikuroi* and *Tetracrium* (*Tuberculatia*) *coccicola*.

Even under the most favorable conditions, these fungi caused only an approximation of commercial control, and when the advent of citrus scab necessitated the elimination of windbreaks to lessen the humidity that favored scab fungus, oil spraying became a necessity. The purple scale has but a single known parasite in Puerto Rico, the Aphelinid wasp *Aspidiotiphagus citrinus* Craw, altho in its host relationships, this wasp is not confined to attacking the purple scale.

Dr. Richard T. Cotton discovered that "The Scale-Feeding Habits of a Porto Rican Millipede, *Rhinocritus arboreus* Saussure" (Jour. Dept. Agr. P. R., 1 (3): 175–6. San Juan, July 1917) might be very effective in cleaning citrus trees of this scale, but actually this had no wide commercial application. Now that the commercial grapefruit industry has ceased to be of major importance, one of the ladybeetles brought to Puerto Rico to feed on the scale of bamboo proves to be an important predator on many other kinds of scales. Not only has the twice-stabbed ladybeetle, *Chilocorus cacti* (L.), been observed to feed on the purple scale, but it occurs in sufficient numbers and continues with such persistence that entire groves are reported to have been cleaned of the scale by it alone.

"**Lepidosaphes gloverii** (Packard) is another citrus-infesting species somewhat resembling the purple scale, but it readily distinguished by its paler color and the much narrower scales", according to Prof. E. O. Essig. It is a rare species in Puerto Rico, having been intercepted here but three times: on grapefruit, lime and guava (*Psidium guajava*), as identified by Dr. Harold Morrison.

Lepidosaphes crotonis Cockerell, as identified by Dr. Harold Morrison, has been found on the coffee shade tree, *Inga vera*, at Utuado.

Lepidosaphes lasianthi Green, which according to Dr. G. F. Ferris is *Lepidosaphes tokionis* Kuwana, has been found on ornamental croton (*Croton humilis*) at Río Piedras, Santurce and Bayamón.

Parlatoria pergandii Comstock, as identified by Dr. Harold Morrison, has been intercepted on grapefruit, tangerine and kumquat in groves along the north coast.

Ischnaspis longirostris Signoret, the black thread scale, was first collected in Puerto Rico by Mr. August Busck on coconut palm at Caguas, Cataño and Mayagüez, and it has since often been noted on this host. Mr. R. H. Van Zwaluwenburg lists royal palm (*Roystonea borinquena*), the Washington palm, (*Neowashingtonia robusta*), "palo de pollo" (*Pterocarpus draco*), and a liana, *Bignonia unguis-cati*. This is a very partial list of hosts, for it has since been found on the corozo, areca, kentia and other ornamental palms, on the asparagus fern (*Asparagus sprengeri*), jasmin, (*Jasminum sambac*), "péndula" (*Cithrarexylum fruticosum*), "membrillo" (*Dalbergia monetaria*), "guaraguao" (*Guarea trichilioides*) and "palo de hierro" (*Ixora ferrea*). Dr. C. W. Hooker reported it on *Ficus repens* at Mayagüez, Dr. Luis F. Martorell (1940–24) on Honduras mahogany (*Swietenia macrophylla*) and Dr. M. R. Smith (1942–23) on coffee. It has been repeatedly noted on the leaves of "laurel de la India" (*Ficus nitida*), those on the road up El Yunque being attacked by the "red-headed fungus", *Sphaerostilbe aurantiicola*, as identified by Miss Charles, who also records attack by *Microcera fujikuroi*.

Pseudaulacaspis pentagona (Targioni), in the older literature referred to as a *Diaspis* or an *Aulacaspis*, was first collected by Mr. August Busck on castor-oil plant at Río Piedras, on honey-locust, on "majagua" at Fajardo and on peach at Adjuntas. Mr. O. W. Barett (1903–446) notes it as very destructive to peach trees in the eastern part of the Island, and also attacking mulberry and pawpaw, to which Mr. W. V. Tower (1907–27) adds plum. Whether because of this scale or for other reasons, peach and plum trees no longer exist in Puerto Rico, and the name "West Indian peach scale" seems most inappropriate. Yet in Hispaniola, at higher altitudes than those under cultivation in Puerto Rico, peach trees are still grown, despite constant infestation by this scale. It is one reason why imported ash (*Fraxinus* sp.) trees failed to thrive in Puerto Rico, and the chinchona trees planted on the barren, wind-swept ridges around Maricao. Almost the only susceptible imported tree to survive is Humboldt's willow (*Salix chilensis*), and various species of mulberry (*Morus* spp.), none of which is at all abundant. Cotton and various malvaceous plants and trees, oleander, cultivated pepper plants and various wild Solanums, besides

numerous native forest trees are sometimes attacked, but the principal host is papaya (*Carica papaya*), so often infested that the scale is most appropriately known at present as the white scale of papaya. In attempting to control the scale on papaya, the oil sprays that had been used so successfully in citrus groves, proved to be equally effective against the papaya scale, but they were also toxic to the host, the leaves of which withered almost as soon as the tree was sprayed. Later developments produced sprays that could be safely used even on tender papaya, but when such sprays became commercially available, it was found that they were quite unnecessary. Water alone, under high pressure from a modern orchard sprayer will dislodge the scales from the smooth cylinder that is the naked trunk of the papaya with an effectiveness that is close to perfection, if the spraying is commenced while only the trunk is infested. The entomogenous fungus *Myrangium duriaei* attacks this scale during wet weather and Dr. H. L. Dozier (1927–277) found it parasitized by *Aspidiotiphagus lounsburyi* Berlese & Paoli. *Aspidiotiphagus citrinus* (Craw) and *Prospaltella diaspidicola* Silvestri have been reared by Dr. Kenneth A. Bartlett, reporting on "The Introduction into Puerto Rico of a Parasite, *Prospaltella berlesei* (Howard), of the White Scale of Papaya" (Agricultural Notes No. 85, pp. 2. P. R. Exp. Station, Mayagüez, March 12, 1938). The most nearly effective of its natural enemies, however, is the imported twice-stabbed ladybeetle, *Chilocorus cacti* L., of which large colonies are often seen on heavily infested papayas. Attempting to transfer some of these beetles to infested trees is rarely a success, for the lizards living on each tree snap them up before their conspicuous black bodies can find concealment on the scale-infested, but otherwise naked trunks of the host.

Aulacaspis (Pseudaulacaspis) major (Cockerell), as identified by Dr. Harold Morrison, was found associated with other scales killing numerous terminal branches of "guara" (*Cupania americana*) at Manatí in September 1940: the only record of this scale from Puerto Rico.

The status of the name of the white scale which Mr. August Busck reports as *Hemichionaspis minor* Maskell, on eggplant at Cataño, and on "guácima" (*Guazuma ulmifolia*) at Guayama, is uncertain and presumably is "not *minor* of Maskell, better as **Pinnaspis strachani** (Cooley)", according to Dr. Harold Morrison. Elsewhere in the tropics it may become a serious pest on cultivated cotton, but has little chance to become abundant on Sea Island cotton in Puerto Rico because of its short crop season. On wild or tree cotton, in Puerto Rico and on Mona Island, it often covers the trunk with a thick white crust, and, to a lesser extent, other malvaceous plants such as "emajagua" (*Pariti tiliaceum*) and "maga" (*Montezuma speciosissima*). It may also attack quite unrelated plants, as mahogany

and eggplant on Mona Island, and in Puerto Rico, most recent records: on "almendrota" (*Barringtonia speciosa*), on "abeyuelo" (*Colubrina ferruginosa*) at Guajataca, on "aceitillo" (*Zanthoxylum flavum*), on "guacimilla" (*Trema micrantha*) at Aguas Buenas, Maricao and on El Yunque. In recent years one may often note the presence of the introduced twice-stabbed ladybeetle, *Chilocorus cacti* L., feeding on the scales. Miss Vera K. Charles lists the white scale as host for the entomogenous fungi *Sphaerostilbe aurantiicola* and *Tubercularia coccicola*.

Pinnaspis buxi (Bouché), a semitransparent, papery, yellowish-brown, oystershell-shaped scale, occurs on the corozo, areca and other ornamental palms, on mistletoe and bromeliads, and may become a serious pest in the commercial production of ornamentals, attacking *Philodendron* spp. and "sanseviera" (*Cordyline terminalis*). As determined by Dr. Harold Morrison, it has been noted recently on *Ilex vomitaria*, introduced from Texas, differing greatly in gross appearance, the scales being oval, very convex and opaquely chalky white or grey in color, matching the bark of the host.

Pinnaspis aspidistrae (Signoret), as identified by Mr. E. R. Sasscer, has been found on the fronds of the Boston fern, *Nephrolepsis exaltata* var. *bostoniensis*.

Dr. C. L. Marlatt described **Leucaspis indica** (Bulletin No. 16, Technical Series, pt. II, pp. 26–27, Bureau of Entomology, Washington D. C., 1908) from material collected on mango at Mayagüez, Puerto Rico, on varieties imported from India, but it has not since been noted.

Aspidiotus destructor Signoret is the most common scale on coconut palm fronds, its round, semitransparent shells, yellow and opaque only in the center, being almost invariably present on the pinnae of mature or fallen fronds. Heavily infested pinnae turn yellow and then become brown and dead, but the actual damage to the tree is questionable because the young fronds are rarely infested. A minute greenish wasp, *Aphelinus chrysomphali* Mercet, is a common parasite of the coconut scale, and may often be seen wandering around over the scales. No native ladybeetle is at all common on coconut palms growing along the beaches of Puerto Rico, and those feeding on this scale in Trinidad, imported into Puerto Rico, find the high winds not at all to their liking. On Mona Island, the twice-stabbed ladybeetle, *Chilocorus cacti* L., (which, so far as we know, got across from Mayagüez by its own efforts) has changed the status of this scale on coconuts so markedly that often mature fronds fall of which the pinnae are still entirely green. A single tree of *Barringtonia speciosa* on Mona, when observed in April 1944, had had its leaves so recently cleaned of this scale that the marks of its former presence were still visible. The coconut scale was first reported from Puerto Rico by Prof. T. D. A.

Cockerell in 1895 (Canadian Entomologist, **27** (9): 253–261), the material having been collected by Mr. J. D. Hill. Mr. August Busck found it only on banana leaves, altho in 1902, Mr. O. W. Barrett reported many coconut trees at Ponce dead from the mass attacks of this scale. Besides coconut palms and bananas, the leaves of aguacate, pomegranate, "mamey" (*Mammea americana*), "almendra" (*Terminalia catappa*), guava (*Psidium guajava*), "corcho" (*Annona pulustris*), the screw palm (*Pandanus* sp.) and the Australian silk oak (*Grevillea robusta*) have been found infested. Dr. H. L. Dozier (1927–277) reared the parasitic wasp *Aspidiotiphagus lounsburyi* Berlesi & Paoli from this scale; Mr. J. A. Stevenson (1918–207) found scales on coconut at Pt. Cangrejos attacked by *Botrytis rileyi*, and Miss Vera K. Charles (1941–717) records attack by *Cephalosporium lecanii*.

Aspidiotus arctostaphyli Cockerell & Robinson, as determined by Dr. H. L. Dozier, was found by him under the leafsheaths of the white-striped variety of gramma grass (*Stenotaphrum secundatum*) at Río Piedras.

Aspidiotus camelliae (Signoret), as identified by Dr. Harold Morrison, has been intercepted on grapefruit at Trujillo Alto.

Aspidiotus hederae (Vallot), as identified by Dr. Harold Morrison, has been intercepted on grapefruit at Trujillo Alto.

Aspidiotus herculaneus Hadden, as determined by Dr. Harold Morrison, has been intercepted on mistletoe (*Phoradendron randiae*) and on "roble" (*Tabebuia pallida*).

Aspidiotus lataniae Signoret, first reported by Dr. C. W. Hooker on rubber (*Castilla elastica*) at Mayagüez, has since been identified by Dr. Harold Morrison from *Jasminum sambac* on Monte Flores Hill, Santurce; from "mamey zapote" (*Achras zapota*) at Naguabo and from "cóbana negra" (*Stahlia monosperma*) at Guánica. Miss Vera K. Charles (1941–758) reports this scale attacked by the entomogenous fungus *Sphaerostilbe aurantiicola*.

Aspidiotus palmae Cockerell, collected by Mr. Thos. H. Jones on eucalyptus at Naguabo in March 1914, was originally identified as *A. cyanophylli* Signoret, and Van Zwaluwenburg's list under the latter name gives nineteen host records. The only recent record is on leaves of "laurel de la India" (*Ficus nitida*) in Muñoz Rivera Park, Puerta de Tierra, in July 1946.

Targionia sacchari (Cockerell), in all the earlier records called an *Aspidiotus*, was first noted in Puerto Rico by Mr. D. L. Van Dine, occurring under the leafsheaths of sugar-cane on the root-stalk and at the base of the stalk just above the surface of the ground. It is a very minor pest of sugar-cane, but quite abundant, much more so than *Aclerda sacchari* Teague. Mr. J. D. Hood (Insecutor Inscitiae Menstruus, **1** (6): 65–70. Washington, D. C., June 1913) reports this scale as found under the leafsheaths of "malojillo" (*Panicum barbinode*) at Guánica.

Pseudaonidia tesserata (de Charmoy), twice found infesting cultivated roses, has also been noted on the twigs of *Inga laurina* at Lares, as identified by Prof. G. F. Ferris.

Selenaspidus articulatus (Morgan), in some of the earlier records called *Pseudaonidia*, was first collected in Puerto Rico by Mr. August Busck on wild orange on El Yunque, at about 2,000 ft. elevation, presumably in Hda. Santa Catalina. It is a round, almost flat, semitransparent, reddish-brown scale, called the "West Indian Red" scale by grapefruit growers, when it later became a major pest in their groves. Of minor importance on grapefruit leaves, on the fruit it gives a freckled appearance, and is the most difficult to remove of any scale when the fruit is being scrubbed and washed for shipment. The Federal Plant Quarantine inspectors made nearly twice as many interceptions of this scale on grapefruit as of any other scale, besides many on orange, two on wild orange or "naranja" (*Citrus aurantium*) and one on kumquat. At Ponce, Cabo Rojo and Mayagüez they intercepted it on tamarind (*Tamarindus indica*), indicating its presence in all parts of the Island, from the most humid on El Yunque to the most xerophytic at Cabo Rojo. Their other interceptions were on *Dracaena fragrans*, on *Malachra alceifolia* at Bayamón, on *Antidesma bunius* at Mayagüez, on *Pothomorphe peltata* at Guaynabo, on *Emelista tora* at Barceloneta, on *Thyella tamnifolia* at Manatí, on *Brunfelsia americana* at Pueblo Viejo, on banana at Arecibo, and corazón at Ponce. It has also been collected on coffee, caimito, pomarrosa and eucalyptus, but is most often noted on the leaves of "laurel de la India" (*Ficus nitida*), being especially noticeable on the freshly fallen yellow leaves. Mr. J. A. Stevenson (1918–219) found it attacked by the entomogenous fungus *Microcera fujikuroi*, and Miss Vera K. Charles lists *Sphaerostilbe aurantiicola*, but no parasitic wasp has been reared from it.

Aonidiella aurantii (Maskell), the so-called "California Red" scale, in older records given as a *Chrysomphalus*, did not occur in Puerto Rico, according to Mr. Harold Compere, until recently, despite the records by Mr. O. W. Barrett (1903–445) on citrus stock, "rare but apparently spreading", listing by Mr. R. H. Van Zwaluwenburg on orange and rose, and the record by Mr. E. G. Smyth on *Murraya exotica*. It was brought in from California, however, around 1936 or earlier, on lemon trees that were planted at Trujillo Alto, whence it spread to orange, kumquat and grapefruit and has been intercepted on these hosts at Río Piedras and Bayamón.

Aonidiella comperei McKenzie is Dr. Harold Morrison's redetermination of the material collected by Mr. August Busck on "guanábana" (*Annona muricata*) at San Juan and Ponce which was reported under the name *Chrysomphalus aurantii* Maskell.

Aonidiella orientalis Newstead (= *Aspidiotus cocotiphagus* Marlatt) was

first collected in Puerto Rico on *Jasminum sambac* on Monte Flores Hill (Santurce) in September 1923, associated with other scales, as determined by Dr. Harold Morrison, but it may occur alone, as Mr. Francisco Seín found the greasy, semitransparent yellow female scales and the plump, white male scales very abundant on the stems of native lima beans (*Vicia faba*) at Guaynabo in February 1943. It occurs on a great diversity of hosts: cultivated grapes, roses, the famous hedge around the Federal Building in San Juan of "café de la India" (*Chalcas* or *Murraya exotica*), banana, tamarind, avocado, hibiscus, "María" (*Calophyllum antillanum*), "aceitillo" (*Zanthoxylum flavum*) at Guánica, and most often on the fronds of the coconut palm.

Chrysomphalus aonidum (Linnaeus), the so-called "Florida Red" scale, is recorded as occurring on grapefruit in Puerto Rico, but rarely in sufficient abundance to be considered an economic pest. It is more abundant on orange and lemon, and because of numerous records on "laurel de la India" (*Ficus nitida*), its other name of *Chrysomphalus* or *Aspidiotus ficus* seems most appropriate. Mr. August Busck collected it on "almendra" (*Terminalia catappa*) at San Juan, on "guanábana" (*Annona muricata*) at San Juan, on oleander at Ponce and on *Musa* at Caguas. Oleander, rose, pomelo, coconut and sisal are added in Van Zwaluwenburg's list, the most recent collections having been made on "mamey del cura" (*Taonabo stahlii*) at Dorado and "almendrota" (*Barringtonia speciosa*), with scales identified by Dr. Harold Morrison. Dr. John R. Johnson (1915–29) records attack on this scale by the entomogenous fungus *Sphaerostilbe coccophila*, and Mr. John A. Stevenson (1918–219) by *Microcera fujikuroi*.

Chrysomphalus dictyospermi (Morgan), as identified by Mr. E. R. Sasscer, was first collected in Puerto Rico by Mr. Thos. H. Jones on mango and on coconut palms, and has since been found on kentia palm at Trujillo Alto, on guava (*Psidium guajava*), and on roses at Bayamón. Heaviest infestations have been noted on the Cycad (*Cycas revoluta*) at Río Piedras and Naguabo.

Chrysomphalus nigropunctatus Cockerell, as identified by Dr. Harold Morrison, was observed heavily infesting the trunk and branches of several trees of lignum-vitae or "guayacán" (*Guaiacum officinale*) on the beach at Salinas.

Chrysomphalus (Melanaspis) portoricensis, described by L. Lindinger (Zeitschrift f. Wissen. Insektbiol., **6** (12): 441. 1910 and **7** (1): 9. 1911) the type from "calambreña" (*Coccoloba excoriata* = *C. venosa*) at Cayey, near Las Cruces, is apparently or "close to" what has since been found on seagrape (*Coccoloba uvifera*) on the beach at Luquillo, and in much greater

abundance temporarily on seagrape at Río Piedras, away from the normal wind-swept beach environment of the host plant, and on *Coccoloba pirifolia* at Maricao.

"**Melanaspis (Hemigymnaspis) eugeniae** sp. nov. aus Porto Rico (Homoptera: Coccidae)" described by L. Lindinger (Entomologische Rundschau, **51** (5): 45–46. March 1, 1934) "auf dem Berg Ciénaga bei Adjuntas" on the leaves of *Eugenia cordata* DC, has subsequently been collected, according to identifications by both Dr. Harold Morrison and Prof. G. F. Ferris, on the leaves of "guayabota de sierra" (*Eugenia borinquensis*) growing on the top of El Yunque rock, and on the trail to the rock: small round black and larger lighter-colored scales present in abundance, along with moss and lichens, on the leaves of the host.

Chrysomphalus personatus (Comstock) was collected by Mr. August Busck on "guanábana" (*Annona muricata*) at San Juan, on banana leaves at Cataño, on plantain leaves at Caguas and on coconut palm at Mayagüez. Mr. Thos. H. Jones (1917–13) found this scale on mango at Santa Isabel and on "laurel de la India" (*Ficus nitida*) in the plaza at Río Piedras and at Mameyes, to which host records Mr. R. H. Van Zwaluwenburg added only *Inga laurina* and the Brazil nut, *Bertholletia excelsa*. It has since been found several times on "mamey" (*Mammea americana*), and repeatedly on *Ficus nitida*, and on eucalyptus at Naguabo, on *Jasminum sambac* at Fajardo, on *Symplocos latifolia* at Bayamón, and on "mangle" (*Laguncularia racemosa*), "María" (*Calophyllum antillanum*), "bejuco de buey" (*Banisteria laurifolia*) and "pomarrosa" (*Eugenia jambos*) at Río Piedras.

Pseudischnaspis bowreyi (Cockerell) was first reported from Puerto Rico by Dr. C. W. Hooker on asparagus at Mayagüez, and Mr. R. H. Van Zwaluwenburg lists it on rose and avocado. It has since been found attacking roses at Ponce, "jobillo" (*Spondias purpurea*) and sisal (*Agave sisalana*).

Furcaspis biformis (Cockerell), in the earlier records referred to as a *Targionia*, is the much more typical scale insect pest of sisal, mentioned by both Van Zwaluwenburg and Thos. H. Jones, and subsequently found at Trujillo Alto, Cayey, Salinas and Cabo Rojo on this host. Dr. Hooker found it on wild pineapple or "maya" (*Bromelia pinguin*), on which it has since been collected at Naguabo, Mameyes and Canóvanas. It also attacks the cycad (*Cycas revoluta*), tuberoses, and the euphorbia, *Pedilanthus tithymaloides*. In 1948 it was first found on cattleya orchids in Puerto Rico.

Pseudoparlatoria parlatorioides (Comstock) in mass infestation on the leaves of the mangrove (*Languncularia racemosa*) at Faro de Cabo Rojo, and on torchwood or "tea" (*Amyris elemifera*) at Dorado, are the only records for Puerto Rico for this scale, as identified by Dr. Harold Morrison.

Pseudoparlatoria ostreata Cockerell, the grey scale of papaya, is quite as abundant and destructive as the white scale, and both scales are sometimes noted infesting a single tree, altho normally, incipent infestations are quite distinct. The grey scale washes off papaya trunks quite easily, and is most acceptable to the introduced twice-stabbed ladybeetle, *Chilocorus cacti* L., but its alternate hosts are quite different. The bright red ornamental bush, *Acalypha wilkesiana*, has repeatedly been noted with heavy infestations, the most recent of which was promptly eliminated by ladybeetles at the Experiment Station in Río Piedras. Bushes of "dama de noche" (*Cestrum diurnum*) may be killed back to the ground, but the fresh shoots coming up from the roots will be reinfested by the time they begin to produce flowers. Infestations on the edging plant "jamón con huevo" (*Achyranthes bettzickiana*) usually end in the entire disappearance of the host. Single instances of infestation on Panamá potato, passion vine and cultivated grape have been noted. No entomogenous fungus and no parasite of this scale is recorded, but the predaceous ladybeetle, *Chilocorus cacti* L., once it becomes established, will prove to be 100% effective in cleaning up an infestation. This was most strikingly demonstrated on Mona Island, where all papaya trees had been cleaned of grey scales by 1944, so completely indeed, that one could but wonder what the "Introduced Lady Beetles on Mona Island" (Jour. Ec. Ent., **37** (3): 451. Menasha, June 1944) could now find to eat.

Aleyrodidae: Whiteflies

The later larval stages of the whiteflies (Aleyrodidae) are immovably fixed in place on the host plant, like those of most of the scale insects, but unlike the scale insects, the adults of both sexes are winged. Admittedly, their flight is not active or powerful, but it renders their dispersion more rapid than that of scale insects, which must depend on the wanderings of the just hatched larvae, or accidents like crawling on the feet of birds, or transportation by man, if they are to reach new host plants. The bodies and wings of whiteflies are not of themselves white, but the entire insect is so evenly covered with a fine opaque powdery wax that it appears white.

Aleurodicus cocois (Curtis), as determined by Dr. H. L. Dozier, is common on the pinnae of coconut palm, and has also been noted in great abundance on the washingtonia (*Neowashingtonia robusta*) and fan (*Coccothrinax argentea*) palms. The much convoluted trails of whitish wax left by the female in laying her eggs terminate in the freshest egg being laid by the female. Despite the abundance of this insect, present on most of the coconut palms of the Island, the injury to the host is negligible, for rarely are any gross symptoms of infestation apparent.

Aleurodicus griseus, described by Dr. H. L. Dozier ("IB" 1936-143)

from an abundance of material on the upperside of the leaves of "hoja menuda" (*Eugenia buxifolia*) and "pitangueira" (*Eugenia ludibunda* = *lancea*), low bushes along the side of the road to Pt. Cangrejos which were destroyed when the widened road was constructed, has since been found on the same hosts at Palo Seco. Bushes in the Guánica forest, tentatively identified as *Myrcia cerifera*, have also been found infested with this whitefly.

Aleurodicus antillensis was described by Dr. H. L. Dozier ("IB" 1936–144) from pupa cases on coconut palm, "María" (*Calophyllum antillanum*) and "bucare" (*Erythrina glauca*) in the San Juan area, but as no subsequent collections have been made, the normal and common host of this species is unknown.

Trialeurodes variabilis (Quaintance), identified by Dr. H. L. Dozier (1926–122) as an *Aleurodicus* (*Metaleurodicus*) from the leaves of papaya (*Carica papaya*), was found by him to be parasitized by "an undescribed and very efficient species of *Encarsia*". This whitefly is common on this host in all parts of the Island, being especially abundant during periods of dry weather.

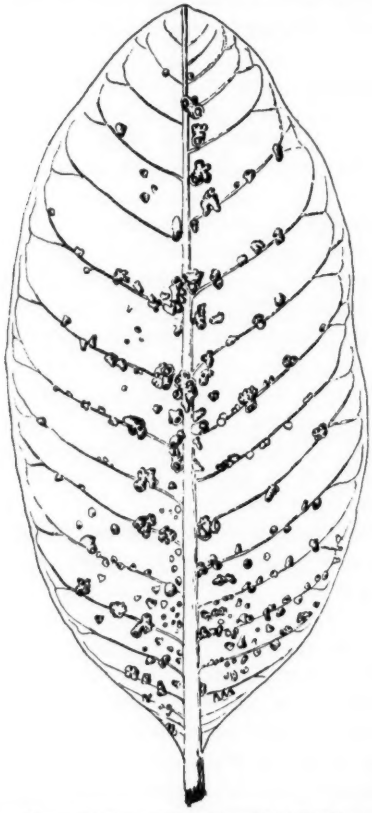
Its known distribution includes St. Croix, Cuba, southern Florida, Mexico, Central America and Trinidad, according to Miss Louise M. Russell, as recorded in "The North American Species of Whiteflies of the Genus *Trialeurodes*" (U. S. D. A. Misc. Publication No. 635, pp. 85, fig. 34, ref. 9. Washington, D. C., March 1948).

Trialeurodes floridensis (Quaintance), described originally from *Psidium guajava*, occurs on many other shrub and tree hosts in southern Florida, the Bahamas, Canal Zone, Cuba and Puerto Rico, according to Miss Russell (1948–19).

Due to attack by the entomogenous fungi *Aegerita webberi*, *Aschersonia aleyrodis* and *Aschersonia flavo-citrina*, by far the most conspicuous whitefly is that on the underside of the leaves of guava (*Psidium guajava*), described by Dr. A. L. Quaintance from Puerto Rico (Technical Bull. No. 8, Division of Entomology, USDA, pp. 47–48. Washington, D. C., 1900) as *Aleurodicus* **minimus.** This has since been transferred to the genus **Metaleurodicus** (Quaintance & Baker 1913–77). The bright red, orange and yellow spore masses on top of the white mycelium of these fungi, first recorded from Puerto Rico by Dr. John R. Johnston (1915–11, 12 & 14), bulk enormous by comparison with the insignificance of the original whiteflies from which they presumably drew all of their nutrients. The same species of whitefly, as identified by Miss Louise M. Russell, occurs on guava bushes at Belém do Pará, Brasil, and is parasitized by *Aschersonia aleyrodis* Webber, as determined by Dr. Petch, who is a specialist in this group of fungi. It assumes economic importance because its attack is so wide-spread on the

whitefly, *Aleurodicus pulvinatus* (Maskell), of Brasilian rubber (*Hevea brasiliensis*) during the rainy season.

Mangrove swamps of *Laguncularia racemosa* at both Ponce and Arecibo in 1941 harbored mass infestations of what Miss Louise M. Russell identified



Colony of *Metaleurodicus minimus* (Quaintance) killed by entomogenous fungi on under surface of leaf of *Psidium guajava*, natural size. (Drawn by Fritz Maximilien.)

as a species of **Metaleurodicus,** very similar to but distinct from *M. minimus* of guava. In 1946, individual but scattered leaves of "mangle botón" (*Conocarpus erecta*) at Faro de Cabo Rojo were found infested.

Leonardius lahillei (Leonardi), the only host of which appears to be mistletoe, is a spotted whitefly whose larvae develop a mass of intermingled curved white threads. It occurs in all parts of the Island, collec-

tions having been made at Jájome Alto, Ciales, Camuy, Mayagüez, Parguera, Guánica and Yauco.

Paraleyrodes naranjae, described by Dr. H. L. Dozier as "An Undescribed White Fly Attacking Citrus in Puerto Rico" (Jour. Agr. Research, **34** (9): 853–5, fig. 3. Washington, D. C., May 1, 1927), was from the wild, sour orange or "naranja" (*Citrus aurantium*), and has not since been collected.

"**Dialeurodes citrifolii** (Morgan), the cloudy-winged whitefly", was found by Dr. H. L. Dozier (1926–121) "infesting sour-orange foliage in private home gardens at Stop 23 and in Río Piedras, the determination being confirmed by Dr. A. C. Baker. It has not so far been observed in any of the commercial groves and is undoubtedly held in check by some natural international parasite and the beneficial fungi. This species in Florida is one of the most serious pests of citrus and it is very interesting to note its lack of spreading or almost complete control on the Island." It has since been found only once, intercepted on lime at Ponce, as determined by Mr. G. B. Merrill. Despite the scarcity of records from Puerto Rico, Miss Vera K. Charles records it as attacked by the entomogenous fungi *Aegerita webberi, Hypocrella disjuncta, H. phyllogena* and *Sphaerostilbe aurantiicola.*

Dialeurodes (Gigaleurodes) buscki, described by Drs. A. L. Quaintance & A. C. Baker (Proc. U. S. National Museum, **51:** 428–9. Washington, D. C., 1917) from material collected by Mr. August Busck, is known only from the type.

Dr. A. L. Quaintance has identified as probably a new species of **Bemisia** the whitefly collected on *Euphorbia hypericifolia* at Río Piedras in 1915. Twenty-two years later, Dr. H. L. Dozier reared from this whitefly, still undescribed, an Aphelinid wasp which he named *Encarsia nigricephala.*

Citrus growers are puzzled and sometimes somewhat needlessly alarmed by finding one or more leaves of their grapefruit trees covered below by a woolly white mass consisting of numerous nymphs of the woolly whitefly, **Aleurothrixus floccosus** (Maskell) (= *A. howardi* Quaintance). Their fears are groundless, for this whitefly has been known from Puerto Rico since 1911, when it was first noted by Mr. W. V. Tower, who reported it (1911–11) also on guava (*Psidium guajava*). It has never become sufficiently abundant since to infest more than a few leaves at a time. From it, Dr. H. L. Dozier (1927–272) reared the parasitic wasp *Thysanus flavus* Girault, and (1932–116) what he described as *Eretmocerus portoricensis*, the previous record of *E. californicus* Howard being based on a misidentification. According to Miss Vera K. Charles, it has attacked by the entomogenous fungi *Aegerita webberi* and *Aschersonia aleyrodis.* Besides orange, grapefruit and Meyer lemon, it occurs on such diverse hosts as "Lignum-vitae, bananas, almácigo, canna, seagrape and many other plants" according to

Dr. Dozier. Miss Louise M. Russell identified it from seagrape (*Coccoloba uvifera*) on Mona Island.

A similar woolly whitefly on the underside of the leaves of the endemic "guayabota" (*Eugenia stahlii*) on El Yunque has been identified as a new species.

Aleurotrachelus trachoides (Back) is often sufficiently abundant on the underside of the leaves of sweet potato, Irish potato, tomato, pepper, eggplant and several species of wild *Solanum* to merit the status of a minor economic pest. Most of these host records are from Van Zwaluwenburg's list, with none of occurrence in the dryer parts of the Island.

Seagrape (*Coccoloba uvifera*) at Isabela and Quebradillas is host for an undescribed species of **Aleurotrachelus.**

Tetraleurodes ursorum Cockerell was collected by Mr. August Busck on *Coccoloba* sp., and it has since been found on seagrape at San Juan.

Tetraleurodes acaciae (Quaintance), as identified by Dr. P. W. Mason, was intercepted on "zarzabacoa" (*Meibomia supina*) at Guaynabo.

Crenidorsum leve, described by Miss Louise M. Russell proposing "A New Genus and twelve new Species of Neotropical Whiteflies (Homoptera: Aleyrodidae)" (Jour. Washington Academy of Sciences, **35** (2): 55–65, pl. 2. Washington, D. C., February 15, 1945), was found seven miles west of Ponce on "uverillo" (*Coccoloba obtusifolia*) and on St. Thomas on *Coccoloba krugii*.

Crenidorsum tuberculatum Russell (1945–57) is also from "uverillo" at Guayanilla.

Crenidorsum stigmaphylli Russell (1945–64) is from El Vigía, Ponce, on *Stigmaphyllon* or "bejuco de toro".

Aleuroplatus vinsonioides Cockerell, as identified by Miss Louise M. Russell, is very different in general appearance from the other whiteflies, the insect itself being black in color. It has repeatedly been collected at the higher elevations in Puerto Rico, on *Ocotea* sp. at Utuado, and on a possible species of *Daphnopsis* on El Yunque, the nymphs excreting five ribbons of white or yellow-green wax: the two broadest ribbons curving back, the two narrower ones forward, with a median narrower one in front.

HEMIPTERA: Bugs

Mr. H. G. Barber's treatment of the "Hemiptera-Heteroptera (excluding the Miridae and Corixidae)" (Scientific Survey of Porto Rico and the Virgin Islands, **14** (3): 263–441, fig. 36, New York Academy of Sciences. New York, July 7, 1939) is one of the most satisfactory of this series. It includes not only all collection records, but keys to all Puerto Rican species of the true bugs, redescriptions of many, and an illustration of every new species he described. For the serious student, it is indispensible. His order of species is here used.

Pentatomidae: Stink Bugs

Corimelaena minuta Uhler, a very convex black "negro bug" of the subfamily Eucoriinae (or Thyreocorinae of the family Cydnidae), whose greatly enlarged scutellum is so large as to almost entirely cover the abdomen, has "a conspicuous marginal orange-red band on the corium" according to Mr. Barber (1939–269), who lists it as of the genus *Allocoris*. Described from Cuba, and found in all the Greater Antilles, it may be much more common than the scanty records of collections in Puerto Rico would indicate. Four individuals were collected on the ground among grass and weeds, including "botoncillo" (*Borreria verticillata*), from three square feet of pasture at Pt. Cangrejos, and Messrs. Lutz and Mutchler found it at Manatí and Aibonito.

In getting ready bouquets of botoncillo flowers in Belém do Pará, Brasil, to accompany shipments of the changa parasite, *Larra americana* Saussure, to Puerto Rico, similar black bugs, *Galgupha vinculata* (Germar) and *G. schultzii* (F.), proved very persistent in clinging to the flower heads. At the time, it was thought that none had been released in Puerto Rico, but in October 1943, Prof. J. A. Ramos collected at Hatillo what he identifies as **Galgupha vinculata** (Germar).

Mr. August Busck collected at Bayamón in 1899 a single specimen of the black **Aethus communis** Uhler, but none has been found since. From numerous humid localities of coast and mountains the dark reddish-brown **Aethus indentatus** Uhler has been collected, and as an item in the food of the iguana, *Ameiva exsul*, was reported under the generic name of *Rhytidiporus*. The scutellum of these Eucoriid bugs is triangular, only moderately large, not entirely covering the abdomen. They are about 6.0 mm. long.

The slightly smaller, highly polished, black **Geocnethus reversus** was described by Messrs Barber & Bruner (Jour. Dept. Agr. P. R., **16** (3): 237. Río Piedras, October 1932) from specimens collected at Mayagüez, Isabela and Río Piedras. On November 20th, 1946, seven individuals, as identified by Dr. Reece I. Sailer, were attracted to light at Río Piedras, altho none had come to this light in the years before, or came subsequently. The collector of the paratype from Río Piedras (December 21, 1911) is not given, and no accession card of the collection at the Río Piedras Experiment Station refers to this specimen.

Geocnethus cubensis B. & B. has been collected by Prof. J. A. Ramos at Mayagüez, as determined by him, and **Geotomus spinolai** Signoret at Humacao and Fajardo.

Little rough, yellowish-brown bugs, **Amnestus pusio** Stål, less than 3.0 mm. long, of which Dr. Gundlach, under the incorrect name of *Amnesus pusillus* Uhler, notes "vuela a menudo hacia las luces encendidas en las casas", still occasionally come to light at night, and if one is tempted to

read in bed, come right thru the mosquito bar and burrow underneath one's body.

Amnestus subferrugineus Westwood is slightly larger and differently colored, all collections in Puerto Rico being from the mountains.

Amnestus diminuatus Barber (1939–274) is very similar, the type from Adjuntas.

The shield bugs (Scutellerinae) have a large convex scutellum covering most of the abdomen as do the negro bugs, but all Puerto Rican species are much larger, and often brightly colored. **Augocoris illustris** (F.) is shining dull orange in color, and apparently not as common now as when Dr. Stahl reported it under the name *Scutellera cretacea* Voet., and Dr. Gundlach as *Augocoris pallidus* H. S., altho Prof. J. A. Ramos has collections from Mayagüez, Indiera (equidistant from Lares, Maricao and Yauco), Aguas Buenas and Fajardo. A large (16.0 mm.) but dull grey specimen, collected at Belém do Pará, Brasil, was but one of many present on botoncillo. Botoncillo (*Borreria verticillata*) is not a host in Puerto Rico, the one recorded host being an ornamental euphorbia. Specimens in Cuba have been taken on the lechesillo tree, and in St. Thomas on the níspero.

Sphyrocoris obliquus (Germar) is reported by Dr. Gundlach, and Prof. J. A. Ramos has specimens from Luquillo. Gundlach's *Mesotrypa sinuosa* Uhler MS is **Symphylus caribbeanus** Kirkaldy, since collected at Ponce and Guánica: a quaint species, grey-brown in color, with a large dark brown spot on the posterior half of the scutellum, out of which is cut an ivory white triangle behind.

Mr. Barber's new **Diolcus disjunctus** (1939–281) is what he previously reported as *D. boscii* (F.), "above closely punctate with green, each puncture rimmed with brown", but the common species is **Diolcus irroratus** (F.), yellowish or reddish brown, shining or dull, densely punctured with brown, 7.0–8.0 mm. long, also collected on Culebra and Mona Islands.

A single specimen of **Tetyra antillarum** Kirkaldy was collected at Guánica by Mr. E. G. Smyth, and subsequently it has been found at Ponce and Mayagüez.

Of **Pachycoris fabricii** L. (= *P. torridus* Scop.) Mr. E. G. Smyth took numerous photographs and wrote an article (Rev. Agr. P. R., **2** (4): 27–31, pl.2. San Juan, March 1919) entitled "Un Insecto Extraño que Cubre su Cría lo Mismo que una Gallina", describing the care taken of her eggs and just hatched young by the female. This is the most common and possibly the most striking of all the shield bugs, the nymphs being a bright iridescent green, the adults somewhat darker and velvety, spotted with orange-red, the four largest spots on the abdomen often coalescing and in a few individuals extending over nearly the entire abdomen. The normal host is wild croton (*Croton humilis* and *Croton discolor*) and *Lantana*

involucrata in arid regions, from Ponce to Hatillo and on Mona Island, but in more humid regions and in the mountains it may occur on other plants.

The iridescent green and orange-red Shield Bug, *Pachycoris fabricii* Linnaeus, twice natural size. (Drawn by Fritz Maximilien.)

Mr. Barber (1939–283) described **Megaris puertoricensis** (subfamily Megaridinae) from specimens intercepted on pomarrosa (*Eugenia jambos*) flowers by Mr. R. G. Oakley at Aibonito: a very broad, fusco-castaneous species, with the scutellum entirely covering the abdomen posteriorly, previously reported as *Megaris semiamicta* McAtee & Malloch.

Of the stink bugs (Pentatominae), the comparatively small **Mormidea cubrosa** Dallas (= *M. sordidula* Stål) and **Mormidea angustata** Stål (= *Mormidea ypsilon* L., as re-determined by Mr. Barber) have been most often found on grass and leguminous forage plants in the western end of the Island. The latter even occurs on Mona Island, its farthest east records being from Guaynabo, Río Piedras and Pt. Cangrejos.

Solubea insularis Stål (= *Mormidea guerini* L. & S.) is even less often collected than **Solubea pugnax** F., early reported by Dr. Stahl as *Pentatoma* (*Mormidea*) *typheus* F., and by Dr. Gundlach as an *Oebalus*. "The Genus **Solubea** (Heteroptera: Pentatomidae)" (Proc. Ent. Soc. Washington, **46** (5): 105–127, pl. 1. Washington, D. C., May 1944) has been discussed at length by Dr. Reece I. Sailer, and a new species described, very near to both *insularis* and *pugnax*, under the name of **ornata.** Despite its ornamental name, it is of considerable economic importance in Hispaniola, and a potential pest in Puerto Rico, because it attacks rice in the milk stage. The type is from Hormigueros, others from Cabo Rojo, together with numerous earlier records from the Dominican Republic and Haiti. In color, its "dorsum (is) dark ferrugineous with large reniform area covering each basal edge of scutellum, apex of scutellum and spot on apical fourth of corium yellow and calloused" and is somewhat less than a centimeter in length. This description applies reasonably well to all three species, the diagnostic specific characters being in the male genitalia.

Equally small for stink bugs are the common, brown densely-punctured

Euschistus bifibulus (Palisot de Beauvois) and **Euschistus crenator** (F.), the humeral angles of the pronotum sharply spined, but not so black and prolonged as in the less common **Euschistus acuminatus** Walker, illustrated in the drawing by Mary Foley Benson (Barber 1939–290). They are sometimes so abundant on beans, tomatoes, tobacco and other cultivated and wild Solanaceous hosts as to become minor pests.

Darker brown, speckled with yellow among the punctures, and with a prominent yellow spot on the posterior tip of the scutellum, **Proxys victor** (F.) has the humeral angles of the pronotum even more prolonged into sharp spines. Despite such formidable armament, Dr. Wetmore found that the ani had eaten it. Present on a variety of host plants in all parts of the Island, it was early reported by Drs. Stahl and Gundlach as *Proxys punctulatus* or *Pentatoma* (*Prionony*x) *punctata* P. de B.

Dull green, a little larger and stouter is **Thyanta perditor** (F.), and also, despite its humeral spines, eaten, according to Dr. Wetmore, by the ani, the mangrove cuckoo and the martin. It has also been found in the stomach of the dark crested lizard, and according to Miss Vera K. Charles is host of the fungus *Beauveria globulifera*. Drs. Gundlach and Stahl collected it first in Puerto Rico, Mr. August Busck at Utuado and Arroyo, and Dr. Frank E. Lutz on Mona Island. Mr. Thos. H. Jones noted both nymphs and adults in abundance on *Piriqueta cistoides*. This can hardly be the only host plant, for adults are often abundant on tomato fruits and on lima beans, as well as on garden weeds and other vegetation.

The much smaller, lighter-colored and spineless **Thyanta antiguensis** (Westwood) (= *T. taeniola* Dallas) is eaten by many more birds, Dr. Wetmore listing the ani, black swift, flycatcher, martin, mockingbird, thrush and Latimer's vireo. It was abundant on Pat McLain's ill-fated lowland rice at Canóvanas, but presumably thrives on other plants. Prof. J. A. Ramos collected a single specimen on Mona Island.

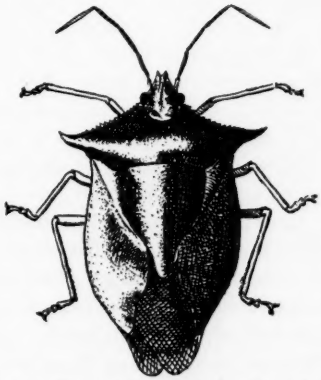
Thyanta casta Stål has a right-angled humeral spine. Mr. August Busck collected it on Vieques Island, and subsequently it has been found on many of the Virgin Islands, and less often in Puerto Rico. Prof. J. A. Ramos collected it on Caja de Muertos, off the south coast near Ponce.

Largest of all the stink bugs of Puerto Rico are the yellow-green **Loxa planifrons,** described by Messrs. H. G. Barber and S. C. Bruner (Jour. Dept. Agr. P. R., **16** (3): 260, figs. 6 & 7, pl. 25. San Juan, October 1932) and the dark green **Loxa pilipes** Horvath (Ann. Mus. Nat. Hungary, **22:** 318, pl. 5, fig. 5. 1925), both described from Puerto Rico, both with impressive humeral spines, saw-toothed anterior margin of pronotum, but the lateral margin straight in the latter and curved in the former. Judging by the localities of collection, *planifrons* is the coastal species, *pilipes* the

mountainous one, listed by Dr. Gundlach under the MS name of *flavicollis* Drury. The nymphs are unknown, as are also the host plants.

The dark green **Fecelia minor** (Vollenhoven) was also described from Puerto Rico (Versl. Akad. Amst., Nat. II, **2:** 179. 1868), very definitely frequenting sour or sweet oranges, as is indicated by numerous interceptions made in all parts of the Island, and noted as "apparently puncturing grapefruit at Las Marías".

The red, conspicuously marked by black **Rubinia perspicua** (F.) has been found on Vieques Island, according to the determination by Mr. Barber of a specimen in the AMC (Mayagüez College) collection, dated xii-35.



Loxa variegata Distant, an Hispaniolan Pentatomid, not known to occur in Puerto Rico, twice natural size. (Drawn by Fritz Maximilien.)

A single specimen of the purple **Vulsirea violacea** (F.) was collected at Ponce by Mr. R. G. Oakley, the only record from Puerto Rico, altho Mr. Barber reports its occurrence "in a number of the West Indian Islands".

The brilliant bluish-green **Pharypia pulchella** (Drury), red-headed and with lateral crimson bands across pronotum and corium, has been quite often collected in the western part of Puerto Rico, and once at Río Piedras.

Of all the Pentatomidae, the southern green stink bug or "pumpkin bug" **Nezara viridula** (L.), is the only one which is often a serious pest, sometimes occurring in large numbers on such vegetables as tomatoes, lima beans and pigeon peas. It may even attack tobacco, extracting so much cell sap that the top of the plant droops. Its early occurrence is attested by the record by Dr. Stahl under the name *Pentatoma smaragdula* F. Dr. Wetmore notes it as an item of food for the ani, kingbird, petchary, flycatcher and a

vireo, and it is also eaten by *Bufo marinus*. The eggs of the Tachinid fly parasite, *Trichopoda pennipes* F., are sometimes seen on the back of the pumpkin bug. This Dipterous parasite is not especially abundant, and as it also oviposits on many other large bugs, it can hardly be considered an especially effective agent in control. The nymphs of the green plant bug are gaily colored and marked, often being accompanied by one or more adults. Hand collection of the nymphs into a bottle partly filled with kerosene and water is a practical method of control for the small-scale vegetable grower, but he needs to be active, or use a net, if the adults are to be caught before they escape by flight. Sabadilla, a powder obtained from the seeds of *Schoenocaulon officinale* of Venezuela, and Ryania, a dust containing the ground stems of the tropical plant *Ryania speciosa*, of which the toxicity to insects has only recently become widely known, are possibly more effective against large Hemiptera than other insecticides, and their use, or of chlordan, against the southern green stink bug is indicated when these become abundant in commercial plantings of vegetables.

Averaging somewhat larger, and darker green is the less common **Acrosternum marginatum** (Palisot de Beauvois), which may be distinguished by "the orifice of the osteolar canal being long and curved, becoming gradually evanescent, extending almost to the posterior lateral angle of the metapleura" according to Mr. Thos. H. Jones. The orifice of the osteolar canal of *Nezara viridula* has a raised margin, most prominent towards the apex, where it is sharply truncated, and "does not extend more than half way to the lateral margin of the metapleura". In habits, both these green plant bugs are alike, and both have been found in all parts of Puerto Rico and on Vieques and Mona Islands.

Banasa herbacea, described by Stål as a *Piezodorus* from St. Thomas, Virgin Islands, had been collected on Vieques by Dr. M. D. Leonard and at Santurce; by Lutz & Mutchler at Ensenada and by Prof. J. A. Ramos in the Guánica Forest.

Banasa humeralis, described by Mr. H. G. Barber (1939–297) from San Germán, is a shining olive-green. Prof. J. A. Ramos has specimens from Mayagüez, Añasco and Luquillo.

Beans and cowpeas are often infested with the small, light green **Piezodorus guildinii** (Westwood), a common and widely distributed little plant bug, found thruout the neotropics. **Piezodorus tinctus** Distant, listed by Dr. Stahl, has been found only once since, at Aibonito.

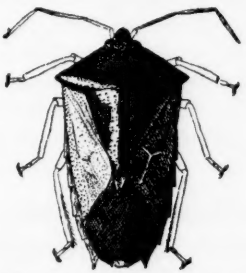
Arvelius albopunctatus (DeGeer), dull greenish yellow, spotted with white on the corium, has black spots on the pronotum and scutellum. Despite sharp humeral spines, the iguana (*Ameiva exsul*) ate this minor pest of tomatoes, eggplant and peppers. Its original host is presumably *Solanum torvum*, on which it is still often found, having been listed by

Drs. Stahl and Gundlach. When a small garden was started on Mona Island, this bug promptly appeared feeding on young eggplants.

Andrallus spinidens (F.) was collected once in flight in a cane field at Guánica by Dr. Luis F. Martorell.

Brepholoxa rotundifrons, described by Mr. H. G. Barber (1939–300) from specimens from Haiti, Ensenada, P. R. and Anegada of the Virgin Islands, is just a centimeter long, "uniformly pale testaceous yellow; lateral margins of head and pronotum, at least anteriorly, ferruginous-tinted". Mr. J. A. Ramos collected one specimen on Mona Island.

The bluntly rounded humeral angle of the green prothorax, the heart-shaped white spot at the tip of the green scutellum, and brown wings should identify **Edessa cornuta** Burmeister (= *E. bifida* Gundlach), 11.0–12.0 mm. long. Mr. E. G. Smyth repeatedly collected eggs, nymphs and adults at Río Piedras on wild morning-glory (*Ipomoea rubra*) and presumably this is the normal host, altho adults have been found resting on numerous other plants in all the more humid parts of the Island. The Plant Quarantine Inspectors intercepted it in citrus groves at Bayamón, Barceloneta and Adjuntas. It was listed by Dr. Stahl as *Aceratodes*, and by Dr. Gundlach under Say's MS name of *bifida*. Dr. Wetmore found it eaten by the ani, and it also serves as an item of food for the crested lizard.



Edessa paravinula Barber. Four times natural size. (Drawn by G. N. Wolcott.)

In the mountainous coffee groves, usually on coffee, but also on citrus, and most commonly at Indiera (equidistant from Lares, Maricao and Yauco) with both adults and nymphs on *Solanum torvum*, is found what was first called *Edessa vinula* Stal or *Edessa affinis* Dallas. Eventually it was described by Mr. H. G. Barber as **Edessa paravinula** (Amer. Mus. Novitates No. 786, pp. 3. New York, March 30, 1935); mostly dark green, with iridescent brownish wings, the veins of the corium being outlined in ivory white or cream.

Alcaeorrhynchus phymatophorus Palisot de Beauvois (of which Mr. Otto Heidemann identified specimens for Mr. R. H. Van Zwaluwenburg

as *Mutyca grandis* Dallas, and Mr. W. L. McAtee later gave the same name), was first collected by Dr. Gundlach in Puerto Rico. It has since been found at Yabucoa, Caguas and Cayey, the only host record being on "palo verde" (*Parkinsonia aculeata*) at Faro de Cabo Rojo.

Of **Podisus sagitta** (F.), "the humeral angle is bifid, with the anterior prong longest and directed outwards" according to Mr. Barber, and the curved posterior end of the scutellum is cream-colored, or at least much lighter in color than the rest of this brownish bug. Twice noticed in cotton fields, in one case it was observed in the act of feeding on the juice of the cotton caterpillar, *Alabama argillacea* Hübner. Mrs. Dexter found it in the stomach of *Bufo marinus*, and Prof. J. A. Ramos collected one specimen on Mona Island.

Podisus mucronatus Uhler, another brown bug with two conspicuous, calloused, yellow spots on the anterior disc of the pronotum, and other similar areas elsewhere, has been collected in cane fields at Guánica and Coloso.

The type of **Podisus borinquensis** Barber (1939–305) was intercepted by Mr. R. G. Oakley at Ponce; its paratype collected by Dr. Richard T. Cotton on coffee leaves at Río Piedras. It was previously recorded under the name of *Podisus sculptus* Distant.

Piezosternum subulatum (Thunberg) is a large, dull, dark green stink bug with blunt humeral angles, but a long, stout spine on the posterior angle of the scutellum. Its nymphs, described in "Insectae Portoricensis" (1923–254) are bright with yellow, orange and black, often noted accompanying an adult or adults. Several times found on coffee in the mountains, or in flight on El Yunque, they also occur on a variety of hosts along the coast.

Coreidae: Squash Bugs

Of all the Coreidae, those with their posterior tibiae flattened and expanded, so that they are called the "leaf-footed" plant bugs, are most striking in appearance. **Leptoglossus gonagra** (F.) is entirely dark brown in color, and has been charged by Plant Quarantine Inspectors Richard Faxon and C. P. Trotter (Jour. Ec. Ent., **25** (3): 446. Geneva, June 1932) with "damaging oranges and grapefruit by puncturing the fruit and extracting the juice, causing a corky area beneath the peel." These bugs occur in all of the more humid sections of the Island, having been noted by Dr. Gundlach, and as *Anisoscelis* listed by Dr. Stahl. Dr. Richard T. Cotton, discussing them as a pest of squashes, notes (Jour. Dept. Agr. P. R., **2** (4): 307. San Juan, October 1918) that the female "lays small, brown, barrel-shaped eggs in a single row on the stems of the vine. These hatch into small, bright red and black wingless nymphs that suck the

juices from the leaves and stems in a manner similar to the adult. These nymphs pass through a number of form and color changes before becoming adults." The adults have also been noted on pumpkins and corn, and resting on other plants, while both nymphs and adults were found feeding on the fruits of the guava (*Psidium guajava*) at Mayagüez, Peñuelas and Arecibo.

Leptoglossus stigma (Herbst) has a distinct yellow band across the corium, the leaf-expansion of its hind tibiae is large, thin and usually with three teeth. Very definitely, its normal host is guava fruits, altho it also has been found on "achiote" (*Bixa orellana*). It is listed by Drs. Gundlach and Stahl, the latter using the name *Anisoscelis serrulatus* H. S.

Leptoglossus cinctus H. S., an Hispaniolan Coreid, not known to occur in Puerto Rico, twice natural size. (Drawn by Fritz Maximilien.)

Leptoglossus balteatus (L.), a less common species with only two teeth in its hind tibial flattening, found in more xerophytic regions, also feeds on guava (*Psidium guajava*).

The bright red nymphs of **Phthia picta** (Drury) and the dark brown adults, usually with a transverse yellow or orange band across the pronotum, congregate in groups on young tomato fruits. Their feeding punctures persist in mature fruits as cores of corky tissue, and the entire fruit is puckered and distorted. Before tomatoes were cultivated in Puerto Rico, these bugs fed on *Solanum nigrum* var. *americanum* fruits, as noted by Mr. Thos. H. Jones (1915–4), and they may also at times feed on melons, pumpkins or cucumbers. Listed by Dr. Gundlach and collected by Mr. August Busck on Vieques, in the garden of the Forest Service on Mona Island they attacked eggplant. As each tomato fruit upon which they feed is ruined for marketing, it is well worth while to hand collect these bugs with a net

and kill them in a bottle of kerosene, if they become at all abundant, for none of the ordinary insecticidal or fungicidal sprays or dusts used on tomatoes has the least effect on them. For extensive plantations, the use of chlordan or of sabadilla or ryania is indicated, the new insecticides which can be used successfully against all these larger bugs.

Mr. H. G. Barber (1939–312) considers the records of *Phthia lunata* F. by Drs. Stahl and Gundlach and in his own preliminary list to refer to **Phthia rubropicta** (Westwood), the West Indian species which has a shining steel-blue head and pronotum, and markings of orange-red. It is quite common at Mayagüez, and has been collected at Utuado, Jayuya, Villalba, Adjuntas and Yabucoa.

Tomatoes, pepper and eggplant are also attacked by **Spartocera** (or *Corecoris*) **fusca** (Thunberg), a large, broad, chocolate brown bug with the thin edges of its abdomen expanded far beyond the margins of its folded wings, and alternately banded with dull yellow and brown. Before Solanaceous vegetables were grown in Puerto Rico, it presumably fed on the fruits of *Solanum nigrum* var. *americanum*, as it sometimes still does, and on those of the cundeamor vine (*Momordica charantia*), as noted by Dr. H. L. Dozier (Rpt. Div. Ent., *in* Ann. Rpt. Insular Expt. Station, 1924–25, p. 116. San Juan, 1926), who also describes the early stages. The earliest collections of this bug were made by Dr. Gundlach and Mr. August Busck.

The first record in Puerto Rico of the somewhat similar, but entirely dull chocolate-brown **Spartocera batatas** (F.), described originally from Surinam, is by Mr. R. H. Van Zwaluwenburg in his 1914 typewritten list, giving as host sweet potatoes. Both Mr. Thos. H. Jones and Dr. R. T. Cotton subsequently reported it as a serious pest on sweet potatoes, and Dr. M. D. Leonard on Irish potatoes at Utuado. Dr. Dozier (1926–116), in addition to life history notes, records its parasitization by *Trichopoda pennipes* F., and destruction by the fungus *Sporotrichum gleosporoides*, which is *Beauveria globulifera* according to Miss Charles. Dr. Wetmore found these big bugs eaten by the ani and vireo, and they also form an item of food for the crested lizard. Clusters of its dull golden eggs were found in abundance on the trunks of bucare trees at Cayey by Dr. Cotton, and have repeatedly been noted on fence posts elsewhere. The freshly hatched nymphs are bright red in color, but in later instars become marked with brown, and at last are entirely dull brown except for the head and protruding angles of the pronotum and segments of the abdomen. Ryania powder will kill the adults, but, surprisingly enough, not the nymphs.

The largest of all the squash bugs in Puerto Rico is **Sephina erythromelaena** (White), velvety black and crimson, of which the adults found at Indiera, June 16, 1921, when that region had first been made accessible by

roads from Lares, Maricao and Yauco, were on a parasitic vine, *Metastelma* sp. Described originally from Brasil, the Puerto Rican specimens were described under the specific name of *indierae* ("Insectae Portoricensis" (1923–251), Mr. H. G. Barber (1939–316) pointing out their identity with those from Perú and British Guiana.

Dr. Gundlach first collected in Puerto Rico the slender brown **Chariesterus gracilicornis** Stål (= *C. moestus*), which has since been taken, or at least found resting on a wide variety of host plants in all parts of the Island. Despite sharply spined humeral angles, it is eaten by the little grass lizard, *Anolis pulchellus*.

Prof. J. A. Ramos has specimens of **Althos obscurator** (F.) from Lares, Maricao and Maricao Forest, and Mr. H. G. Barber (1939–318) corrects the record of the one from Aibonito as a *Margus* in his preliminary list (1923–12).

Mr. August Busck collected on Vieques Island the slender yellowish-brown **Catorhintha guttula** (F.), densely punctured with brown, more especially characterized by a prominent spine on the outer angle of the antenniferous tubercle. It has since been collected on Mona Island, feeding on corn leaves, and at many localities in Puerto Rico on a variety of hosts. On the south coast it is especially abundant on the sticky-capsule vine, *Commicarpus scandens*. Dr. Wetmore found it in the stomach of the ani.

Mr. H. G. Barber (1939–319) has described **Catorhintha borinquensis** from a specimen collected at Coamo Springs, and other specimens have since been intercepted at Aibonito and Villalba by Mr. R. G. Oakley.

Anasa scorbutica (F.) is a broader, darker bug, the median dorsal part of its abdomen being bright chestnut in color, and the outwardly curving spine of the antenniferous tubercle prominent. Altho elsewhere a pest of curcurbits, it is hardly that in Puerto Rico, the record of greatest abundance being in a cane field at Fajardo.

Zicca taeniola (Dallas), dull yellow with ivory tipped scutellum and spot on corium, sharp humeral angles, listed by Dr. Gundlach and in Van Zwaluwenburg's list, is an inconspicuous little bug that Mr. E. G. Smyth found on curcurbits at Añasco, and in great abundance on the seed heads of the weed blero (or "bledo") at Guánica. Presumably this last record indicates the normal host: *Amaranthus*, checking with interception at Cidra on cockscomb.

By far the most beautiful and quite the most interesting of all Coreids is **Sphictyrtus whitei** (Guérin-Méneville). Crimson, black and iridescent green above, the abdomen yellow or orange in color, the adults swarm at times in such abundance on Mona Island as to bend down the branches of trees on which they cluster. Described originally from Cuba, where it is

rare, and in addition known only from a single "specimen in the United States National Museum collection labeled San Salvador, Bahamas (Bartsch)" according to Mr. Barber (1939–321), it has never been found in Hispaniola or Puerto Rico, or even on Desecheo. Despite the usual abundance of adults on Mona Island, neither eggs nor nymphs have been discovered, and the clusters of adults are not feeding on the plants on which they are resting. Mr. Francisco Seín thought that they might be feeding on corn when he visited Mona in 1926, but since beefwood trees (*Casuarina equisetifolia*) have been planted in the level sandy region along the west coast, these introduced Australian trees have been preferred for clustering upon. Close to Camp Kofresí, those most heavily infested with cottony cushion scale have greatest numbers of these bugs, disputing with paper-nest wasps, *Polistes crinitus* Felton and *Polistes major* P. de B., and invariably retreating and flying off with a loud buzzing sound to land on another branch of the same tree. In September 1944, they were comparatively scarce, and Prof. J. A. Ramos did not observe them in April 1935, but these are the only times that visiting entomologists have failed to find them in overwhelming abundance on Mona.

Dr. Frank E. Lutz collected a single specimen of **Hyalmenus longispinus** Stål on Mona Island when he was there in February 1914.

The slender **Megalotomus rufipes** (Westwood), listed by Dr. Gundlach as *Alydus pallescens* Stål, is quite common on leguminous crops and weeds. Its spiny hind legs did not prevent its being eaten by the little grass lizard, *Anolis pulchellus*.

The longest and most slender of the squash bugs found in Puerto Rico, and most untypical, is **Leptocorisa filiformis** (F.), first collected here by Dr. Gundlach, and subsequently in all parts of the Island, often on sugar-cane, and most recently on Mona Island by Dr. Luis F. Martorell.

Harmostes serratus (F.) was intercepted on dahlia at Cidra, and several times elsewhere on the Island, without host record. Mr. Harold E. Box collected **Harmostes affinis** Dallas at Aguirre. Mr. H. G. Barber himself collected **Xenogenus extensum** Distant at San Juan.

Liorhyssus hyalinus (F.), previously reported from Puerto Rico as a *Corizus*, is also most untypical of the squash bugs: a little, bright-colored insect with hyaline wings, common on Solanaceous vegetables and weeds in all parts of the Island, as well as on Vieques and Mona. The little grass lizard eats it, and also eats **Niesthrea vincentii** (Westwood). The latter, listed by Dr. Gundlach and more recently as *Corizus sidae*, occurs in all parts of Puerto Rico, and on Mona, Desecheo (Lutz), Vieques and Culebra (Busck), but shows no exclusive host preferences, having been found in abundance on bledo flower-heads, on malva (*Malachra alceifolia*) fruits,

and at Boquerón in all stages in great abundance on *Waltheria americana*. The eggs and nymphs are described in "Insectae Portoricensis" (1923–249.)

Mr. H. G. Barber considers his **Jadera rufofusca** (1939–328) as the only species of this genus occurring in Puerto Rico, despite all the other names listed, including *Serinetha coturnix* Burmeister, which Dr. Gundlach gave in synonymy. With pinkish head and body and light brown wings and legs, the shape suggests that of the cotton-stainers, but the ocelli are large and prominent, and the adults show a surprising indifference to living vegetation. Hundreds were noted at Guánica resting on the shady side of a dry fence post, and they often come to light in numbers. Mr. R. G. Oakley intercepted them on "úcar" and on the sedge "junco" at Ponce. Most recently nymphs were found at Barceloneta on *Serjania polyphylla*.

The continental **Jadera haematoloma** Herrich-Schaeffer, previously known only from Cuba in the West Indies, was found in abundance, both nymphs and adults, "under dead leaves and on the dry culms of guinea grass" on Mona Island by Prof. J. A. Ramos (1947–30). It is red and black in color, with a conspicuous median carina on the pronotum.

Aradidae: Flat Bugs

Of the flat bugs, the two Puerto Rican records given by Mr. H. G. Barber (1939–330) for the rather large black **Mezira abdominalis** (Stål) are of collection at Mayagüez (Landrón) and of listing without locality by Bergroth.

Eretmocoris tatei, described by H. M. Harris and C. J. Drake as one of "New Apterous Aradidae from the Western Hemisphere (Hemiptera)" (Proc. Ent. Soc. Washington, **46** (5): 128–132. Washington, D. C., May 1944), is from a single male collected at Lares, "small (length 3.4 mm., width, 1.55 mm.), reddish brown, oblong-ovate", both head and thorax ridged, the "antenniferous tubercles very prominent".

Drs. Donald De Leon and L. F. Martorell found beneath the moist bark of a "corcho" (*Pisonia subcordata*) tree at Camp Buena Vista at Maricao, the oval grey eggs, the light brown nymphs and the darker adults of what Mr. H. G. Barber identified as **Aneurus** sp., near *minutus* Bergroth. Mr. Barber's preliminary list gives *Aneurus politus* Say for specimens collected in decaying wood at Adjuntas which are re-described in his final paper (1939–330) under the name **Aneurus minutus** Bergroth.

Neididae

Mr. H. G. Barber (1939–331) describes **Jalysus reductus** from a single type collected on Mona Island by Dr. Frank E. Lutz, and many paratypes from Trinidad, Cuba, Hispaniola, Mexico and Panama. A very slender bug, it has extraordinarily long legs and antennae.

Lygaeidae: Chinch Bugs

Possibly the least typical of the chinch bugs is the large orange-red and black milkweed bug, **Oncopeltus fasciatus** (Dallas), common everywhere in Puerto Rico, on Mona and Culebra Islands on *Asclepias curassavica*. It is often attracted to lights, but quite consistently feeds only on milkweed.

Oncopeltus aulicus (F.), crimson and black, with a white spot like a drop of milkweed juice on the wings, is apparently comparatively rare in Puerto Rico, the only collection authoritatively determined being that by Dr. W. A. Hoffman at San Juan. In 1899 Mr. August Busck found it on Vieques Island, and Dr. Luis F. Martorell collected it in abundance on Mona Island on the flowers of "abeyuelo" (*Colubrina ferruginosa*), and fewer on the flowers of "corcho" (*Pisonia albida*) and *Moringa oleifera*.

The Milkweed Bug, *Oncopeltus fasciatus* (Dallas) three times natural size. (Drawn by Fritz Maximilien.)

The very similar but more extensively black **Oncopeltus semilimbatus** Stål also occurs on Mona Island, most recently noted on castor bean (*Ricinus communis*), but not at all in Puerto Rico.

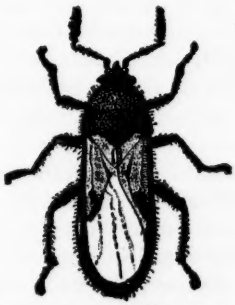
Lygaeus (Craspeduchus) pulchellus F., a little black bug neatly and evenly margined in pale yellow, the lateral margins of pronotum red, was described by Fabricius from St. Croix (1794), and its name remains unchanged to date. It occurs in the other Virgin Islands, and Dr. W. A. Hoffman found it on Mona, and specimens collected by Mr. R. H. Van Zwaluwenburg are from Añasco. Dr. Richard T. Cotton found adults in abundance mating on *Corchorus hirsutus* at Pt. Cangrejos, February 20th, 1916. More recently, April 5, 1944, they were present in abundance on this host at the airport on Mona Island, but not mating.

The posterior two-thirds of the pronotum of **Lygaeus (Ochrimus) collaris** F. is red; another bug retaining the original name given it in 1803, the type from St. Thomas. Often coming to light at many points in

Puerto Rico, the only record of mating is for January 20th, 1940 at Aguadilla. Dr. Luis F. Martorell found it abundant on "corcho" (*Pisonia albida*) on Mona Island, the only record of a host plant.

Mr. H. G. Barber described **Lygaeus (Melanocoryphus) albonotatus** (1939–337) from a single specimen from Mona Island, and **Lygaeus coccineus** (1939–339) from collections made by Dr. Frank E. Lutz at San Juan.

The little grey **Ortholomus jamaicensis** (Dallas) was earliest collected by Mr. August Busck on Vieques Island, but it is common in Puerto Rico. The earliest host record is by Mr. Thos. H. Jones, who found all stages abundant on *Hyptis pectinata*, but later collections have been made on milkweed.



The Chinch Bug, *Blissus leucopterus* Say. Fifteen times natural size. (After Webster.)

The chinch bug, **Blissus leucopterus** (Say) var. **insularis** Barber, is sometimes a major pest of guinea grass in the region west of Arecibo, and has been observed to kill out extensive patches of malojillo at Manatí during extreme dry weather. The introduced Java grass, *Polytrias amaura*, is especially susceptible to attack, even in normally humid regions. Rice and corn are more rarely attacked, and instances of infestation on sugarcane are rare. One sometimes sees a few adults on young cane during dry weather, but these are mostly migrants from surrounding grassy margins. The chinch bug occurs on Vieques and Mona Islands, as well as in northern Puerto Rico, but hardly at all on the xerophytic south coast. All of the smaller lizards eat the chinch bug, and it constitutes 10 per cent of the normal food of the little grass lizard, *Anolis pulchellus*, at Río Piedras. Obviously, these little lizards are an important factor in control, and possibly one reason why outbreaks occur in the northwestern part of the Island is the relative scarcity of lizards in pastures and cultivated guinea grass fields there.

Nysius basalis Dallas (= *inaequalis* Uhler), **Nysius tenellus** Barber 1947 (= *strigosus* Uhler), and **Nysius ericae** (Schilling) (prob. = *N. scutellatus* Dallas) have all been collected on Mona Island repeatedly, as well as in Puerto Rico, the first, "pale testaceous, punctate with brown", also on Desecheo by Mr. H. E. Crampton. The latter is common in the States, being a rather serious pest, called the false chinch bug, but in Puerto Rico it is known only from the mountains, at Caguas and Adjuntas. *Nysius strigosus* was found by Mr. A. S. Mills on *Pluchea purpurascens* at Pt. Cangrejos.

Pluchea purpurascens also proved to be host for **Cymus virescens** (F.), which Mr. R. G. Oakley intercepted on mangrove at Ponce.

The very small **Kleidocerys championi** (Distant) was collected on "fresas" (*Rubus rosaefolius*) at Aibonito by Mr. Oakley, by Prof. J. A. Ramos on *Sawagesia erecta* in the Guánica Forest, by Dr. Luis F. Martorell on sugar-cane at Guayanilla, and by numerous other collectors in other parts of Puerto Rico. Mr. H. E. Crampton found it on Mona Island, where Prof. J. A. Ramos, as an *Ischnorhynchus*, reports it (1947–26) as "exceedingly abundant".

Cymoninus notabilis (Distant), of which the first record in Puerto Rico is swept from grass by Dr. Richard T. Cotton at Río Piedras, has subsequently been found at many points on the Island.

The little black **Ischnodemus sallei** (Signoret) occurs in the mountains of Puerto Rico, as does also **Ninyas deficiens** (Lethierry).

A single **Geocoris thoracicus** (Fieber) Dr. Wetmore found eaten by the tody. It is a small black Lygaeid occurring in the most xerophytic part of the Island. Prof. J. A. Ramos collected specimens at Faro de Cabo Rojo, and also on Mona Island.

Pachygrontha bimaculata Distant is common on weeds in the spring at Mayagüez according to Prof. J. A. Ramos. Mr. H. G. Barber (1939–348) described the much smaller (4.5 mm. long) **Pachygrontha parvula** from Mona Island.

Mr. August Busck in 1899 collected the single specimen of **Ligyrocoris litigiosa** (Stål) known from Puerto Rico, and Mr. H. G. Barber in 1914 the only specimen of **Ligyrocoris abdominalis** (Guérin-Méneville), at Ponce.

Paromius longulus (Dallas), first recorded from Puerto Rico under the name *Pamera*, is a very elongate dark little bug which has been collected generally in grapefruit groves in Puerto Rico: on weeds or crotalaria, and has also been found on Desecheo and Mona Islands.

Under the name *Orthaea ferruginosa*, Mr. H. G. Barber listed (1923–4) what he subsequently (1924–136) renamed **Pachybrachius intermedius,**

of which specimens have been collected at Cataño, Isabela, Mayagüez, Maricao and Adjuntas. It also occurs in Hispaniola and Cuba.

Pachybrachius vinctus (Say) appears to be the common species of the genus, first reported from Puerto Rico by Dr. Gundlach as a *Pamera*, and later reported as an *Orthaea* from all parts of the Island. It also occurs on Mona and Vieques Islands. It was this species of which Mr. Thos. H. Jones found nymphs feeding on *Piriqueta cistoides*, altho adults have been noted on many other hosts. All the smaller lizards eat these bugs in considerable numbers: the records being lumped under the name of *Orthaea bilobata*. **Pachybrachius bilobatus** (Say) is somewhat larger than the others, and almost as common as *vinctus*. **Pachybrachius servillei** (Guérin-Méneville) is comparatively rare in Puerto Rico. Prof. J. A. Ramos collected **Pachybrachius scutellatus** (Dallas) at Mayagüez, and specimens from Mona Island were thus identified by Mr. H. G. Barber.

Heraeus guttatus (Dallas), of which a single specimen was collected at light at Isabela by Dr. M. D. Leonard, has been found by Prof. J. A. Ramos on Mona Island.

Exptochiomera minima (Guérin-Méneville) has been found at Aguirre, Ensenada, San Germán and Adjuntas.

Ozophora burmeisterii (Guérin-Méneville) and **Ozophora pallescens** (Distant), judging by the number of collections, are the least abundant of this genus in Puerto Rico. The three new species described and illustrated by Mr. H. G. Barber (1939–356 to 360): **atropicta, subimpicta** and **quinquemaculata** are the more common, the latter especially on Vieques Island, and *atropicta* on Mona and Andros Islands, and in Hispaniola. Prof. J. A. Ramos has described in "The Insects of Mona Island, West Indies" (Jour. Agr. Univ. P. R., **30** (1): 1–74, pl. 2., ref. 45. Río Piedras, December 31, 1947) **Ozophora octomaculata** from Mona Island, "readily distinguished by the eight conspicuous yellowish-orange spots on the pronotum", of which his illustration is reproduced on page 139.

Paragonatas divergens (Distant), first collected in Puerto Rico by Mr. Francisco Seín at Lares, has since been taken by Prof. J. A. Ramos at Mayagüez, and by him also on Mona Island.

Of **Clerada apicornis** Signoret, Dr. Gundlach noted "se encuentra en toda la isla", but recent collections have all been made in the western end of Puerto Rico, despite its cosmopolitan world distribution.

Pyrrhocoridae: Cotton-Stainers

The plumpest of the cotton-stainer bugs is **Largus obovatus,** described as a *Euryophthalmus* by Mr. H. G. Barber (1923–5) from Hispaniola and Puerto Rico. It is mostly blue-black in color, with the front margin of the

wings and the rear of the pronotum bright red. It has been found most often on coffee, or coffee shade-trees in the mountains, as well as on wild orange and on bromeliads on bucares. Despite the reputation of cotton-stainers being avoided by predaceous animals because of warning colors indicating unpleasant odor or taste, one of these plump and juicy bugs was found to have formed an item of food for the crested lizard.

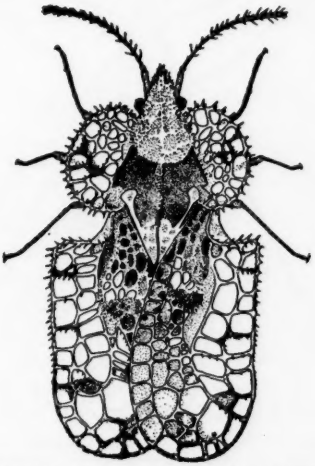
The somewhat larger and more brightly colored cotton-stainer, **Dysdercus sanguinarius** Stål (= *D. neglectus* Uhler & *D. jamaicensis* Walker), which may be distinguished by the pale posterior margin of the pronotum, is not very common, and is only a minor pest of cotton. It has been found on the fruit of *Sterculia apetala* at Mayagüez, and Mr. L. Courtney Fife, reporting on his three year's observations on the "Insects and a Mite found on Cotton in Puerto Rico, with Notes on their Economic Importance and Natural Enemies" (P. R. Agr. Expt. Station Bulletin No. 39, pp. 14, ref. 45. Washington, D. C., March 1939) found it "numerous on maga (*Montezuma speciosissima*) and to a lesser extent on clamor (*Thespesia populnea*)."

The common cotton-stainer in Puerto Rico, present also on Mona and Culebra Islands, is **Dysdercus andreae** (L.), first reported from the Island by Mr. O. W. Barrett (1905–396) as *Dysdercus suturellus* Herrich-Schaeffer, a species which is not found here. It is by no means so numerous or so serious a pest in Puerto Rico as in Hispaniola, or in the cotton-growing Lesser Antilles, but it sometimes becomes locally abundant towards the end of the cotton picking season. Mr. Fife (1939–8) counted 20 per cent of all bolls injured, principally by this species, and considers "the staining and discoloration of the lint caused by the boll-feeding habits of various species of hemipterous insects materially reduces the grade of the entire crop, and, therefore, its value". Both adults and nymphs feed on the juice of cotton seeds, preferably attacking those most nearly mature or in the bolls that opened ahead of the majority in the field, but when cotton seed is not available, they are often found on those of the "ceiba" (*Ceiba pentandra*), and of the endemic "maga" (*Montezuma speciosissima*). Mr. Fife noted that "the most favorable host of *D. andreae* is *Thespesia populnea*, on which it may be found during the entire year; *Abutilon hirtum* and *Sida* sp. also serve as hosts".

Tingidae: Lace Bugs

The specific name of the most common of the lace bugs in Puerto Rico, **Corythucha gossypii** (F.), was doubtless correct for the particular specimens described, for it is still found, rarely, on cotton. Mr. L. Courtney Fife (1939–9) mentions it as a pest of cotton, but considers the damage caused to be negligible. The normal hosts are lima bean, sword bean and

castor bean, and to a much lesser extent, such unrelated plants as Meyer lemon (*Citrus excelsa* var. *davaoensis*), orange, grapefruit, soursop, breadfruit, yautía and papaya. As observed by Dr. Luis F. Martorell, such forest trees as "aceitillo" (*Zanthoxylum flavum*), "carubio" (*Zanthoxylum monophyllum*), "espino rubial" (*Zanthoxylum caribaeum*), "sapo" (*Capparis baducca*) and especially *Isandrina emarginata*, may have their leaves so heavily infested that they turn yellow and drop. Common everywhere in Puerto Rico, it has been noted on *Ichthyomethia* (or *Piscidia*) *piscipula* and castor bean on Vieques Island, and on the latter host on Mona. Prof. J. A. Ramos found it on "palinguán" (*Capparis flexuosa*) on

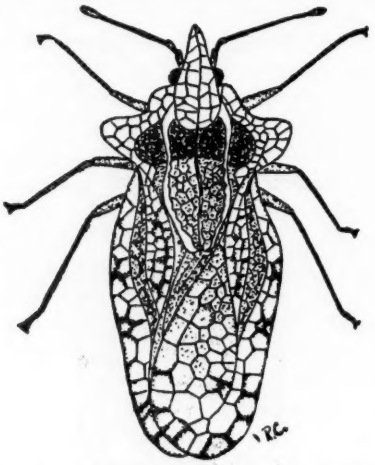


The Bean Lace Bug, *Corythucha gossypii* (Fabricius), twenty times natural size. (Drawn by Francisco Seín.)

Mona Island. "Observations on the Bean Lace Bug in Porto Rico" (Jour. Dept. Agr. P. R., **15** (3): 309–323, fig. 1, pl. 2, ref. 44. San Juan, September 1931) by Dr. M. D. Leonard and Mr. A. S. Mills give its life-history in detail.

The eggplant lace bug, another broad, light-colored species, **Corythaica cyanthicollis** (Costa) (= *C. planaris* Uhler, not *C. monacha* Stål, which is exclusively South American) is a very serious pest of eggplant, and all the more difficult to control because of constant re-infestation from wild eggplant, *Solanum torvum*. Exceptionally it may occur on tobacco, tomato and cabbage. The poorest farmer may save his eggplants during dry weather, however, for common laundry soap, 1 to 100, will kill both nymphs and adults. On larger plantations, much greater dilutions of pyrethrum

and rotenone have been used successfully, but it is against such insects as these which have no parasites or predators, and live on parts of the plant not used as food by domestic animals or human beings, that DDT and gamma isomer of benzene hexachloride can be used most effectively. All of the lace bugs become abundant during dry weather, and their populations sink to insignificant numbers during wet weather, possibly in part due to attack by the entomogenous fungus, *Acrostalagmus aphidum*. The little grass lizard eats these bugs, but not in large numbers. The best and most extensive account of "The Egg-plant Lace-Bug in Porto Rico" was written



The Eggplant Lace Bug, *Corythaica cyanthicollis* (Costa), twenty times natural size. (Drawn by R. T. Cotton.)

by Dr. R. T. Cotton (Jour. Dept. Agr. P. R., 1 (3): 170–3. San Juan, July 1917).

Corythaica carinata Uhler is a much less common and more elongate species, also found on eggplant, and, as determined by Dr. H. L. Dozier, on *Urena lobata* at Dorado.

Yatiga illudens (Drake), earlier reported as a *Leptopharsa*, and by Mr. H. G. Barber described (1923–6) under the name *Atheas pallidus*, a very delicate-looking, elogate, waxy-white species, is a minor pest of yuca (*Manihot* sp.).

The type of **Leptodictya bambusae** Drake was from bamboo at Mayagüez (Ohio Jour. Science, **18** (5): 175. March 1918) and is rather abundant there.

Teleonemia sacchari (F.), large, dark, and elongate, has nothing to do

with sugar-cane, so far as known. Its hosts, as noted in Puerto Rico, are *Sawagesia erecta* in the Guánica Forest, where it was collected by Prof. J. A. Ramos, who also found it on Mona Island, and on Verbesina flowers by Mr. E. G. Smyth. It is eaten by the crested lizard.

Lace bugs collected at Isabela by Prof. J. A. Ramos has been identified by Mr. H. G. Barber as **Teleonemia prolixa** Stål.

Monanthia monotropidia Stål is a very serious pest of the younger trees of "capá prieto", as is indicated by repeated collection by Dr. Luis F. Martorell, in all parts of the Island, on *Cordia* (*Cerdana*) *alliodora*, of this very dark lace bug.

Monanthia c-nigrum Champion was collected by Dr. Stuart T. Danforth at Joyuda, and subsequent collection have been made at San Germán and Hatillo.

Phymatidae: Ambush Bugs

Phymata marginata (F.) is one of the smaller but possibly the most common of the ambush bugs in Puerto Rico. Noted by Dr. Gundlach, and also under the name *Phymata erosa* L., Dr. Wetmore found that these bugs had been eaten by the tody, a vireo and a warbler, the yellow-shouldered blackbird and by the ani. They have been collected in all parts of the Island, resting on various plants and flowers.

The ambush bugs of the genus *Macrocephalus* have a very large scutellum, covering most of the abdomen. **Macrocephalus spiculissimus,** described by Mr. H. G. Barber (1939–374), is densely covered with spicules as both adult and nymph. The spicules give it an appearance very similar to the hairyness of the twigs of *Inga vera*, one of the coffee shade trees, on which all specimens have been found: a protective resemblance that should be most useful to a predaceous insect that depends for its nourishment on other unsuspecting insects walking into its clutches.

Macrocephalus productus, also described by Mr. Barber (1939–377) has enormously produced laterally the flattened edge (connexivum) of the first two abdominal segments, and the lateral margins of the pronotum. The type was found on another coffee shade tree, *Inga laurina*, at Aibonito.

Macrocephalus crassimanus (F.) is a rather narrow, elongate species, found in xerophytic southwestern Puerto Rico as well as in the mountains, and is possibly what Dr. Wetmore found in the stomach of a tody. The living insect is light green in color, yellow on the sides, marked with brown on the prothorax and head, with reddish eyes and two red spots on the wings. This is the species which was previously incorrectly reported in "Insectae Borinquenses" (1936–160) as *M. bergrothi* Handl., on *Inga laurina* at Lares.

Macrocephalus leucographus Westwood is smaller, with the rear part of

the connexivum greatly produced laterally, almost paralleling a similar exfoliation of the pronotum. Previously reported ("Insectae Borinquenses" p. 160) as *M. granulatus* Champion, on coffee at Lares, it is also to be found along the north coast, the most recent collection being at Vega Baja, on flowers of "botoncillo" (*Borreria verticillata*), waiting for some little bee or fly to come within its grasp.

Extraneza nasuta was described by Mr. H. G. Barber (1939–380) from a single specimen intercepted by Mr. R. G. Oakley in the mountains above Yauco. It has an extraordinarily long head, longer than the pronotum.

Enicocephalidae

Mr. H. S. Barber notes a species of *Systellerodes* from Puerto Rico, and describes (1939–383) **Enicocephalus semirufus** from specimens collected at Adjuntas and Indiera. Prof. J. A. Ramos found the latter quite abundant in forest litter from the Maricao Forest.

Enicocephalus usingeri was described by Mr. Jenaro Maldonado Capriles as "A New *Enicocephalus* from Puerto Rico" (Proc. Ent. Soc. Washington, **50** (6): 159–160, fig. 3. Washington, D. C., June 1948) the types, captured in light traps at El Yunque, being characterized by having extremely large eyes.

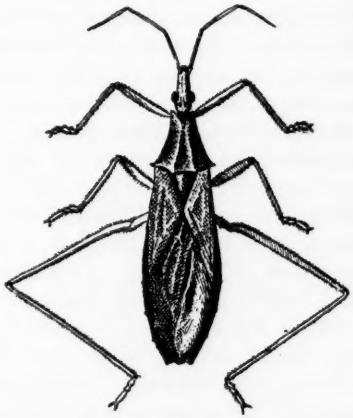
Reduviidae: Assassin Bugs

All of the Reduviid bugs are predaceous, but while some are large and conspicuous, others are small and slender. Of these comparatively minute forms, **Emesopsis nubilis** Uhler, **Empicoris rubromaculatus** (Blackburn) and **Empicoris armatus** (Champion) were collected by Dr. M. D. Leonard on Vieques Island, all of them also occurring in Puerto Rico. As a *Ploiariodes*, Messrs McAtee & Malloch (Amer. Museum Novitates No. 75, p. 7. New York, 1923) described **Empicoris barberi** from Tallaboa, Puerto Rico, and it has also been collected at Río Piedras.

Emesa affinis longipes DeGeer, as determined by Dr. Uhler, is the name given by Dr. Gundlach for his specimens of the Ploiariinae. **Ploiaria (Luteva) yunquensis,** the type from El Yunque, **Ploiaria (Luteva) maria,** the type from Ponce, others from Tortuguero Lagoon, and **Ploiaria (Luteva) poncei,** type and others from Ponce, were described as new species, differing from *P. (L.) gundlachi* (Dohrn) in the dorsolateral process on the male hypopygium, by Mr. Jenaro Maldonado Capriles (Proc. Ent. Soc. Washington, **50** (1): 18–22, pl. 1. Washington, D. C., January 1948). According to Mr. H. G. Barber's key (1939–385), the light grey Emesid spotted with black which Mr. E. G. Smyth found on thrips-infested jobo leaves is **Ploiaria gundlachi** (Dohrn), and what Smyth actually caught in the act of devouring a mosquito, resting on the walls of a room of a house

at Río Piedras, should be **Emesa tenerrima,** which Dohrn (Linn. Eng., **14:** 251. 1860) as a *Westermannia* described from Puerto Rico. As an *Emesa,* Dohrn also described (1860–266) **Ghilianella varicornis** from Puerto Rico. The very much larger **Ghilianella longula** McAtee & Malloch, 30 to 38 mm. long, has been collected at El Yunque and at Aibonito. Prof. J. A. Ramos found both the latter at Mayagüez.

The slender **Pnirontis infirma** Stål, "with ramose spines behind eye," and elbowed antennae folded up beneath a prominent beak, is sometimes attracted to lights in houses, and has been collected at Río Piedras, Isabela and Mayagüez. Mr. E. G. Smyth at Río Piedras in 1916 found them "quite common on flower heads of Amaranthus and other weeds, where they possibly capture the Capsids".



The Assassin Bug, *Stenopoda cinerea* Laporte, twice natural size. (Drawn by Fritz Maximilien.)

Much larger and broader and darker, the wings marked with dark brown, is **Stenopoda cinerea** Laporte, listed by Dr. Stahl, which Dr. Gundlach reported under Fabricius' preoccupied name of *culiciformis.* It also is attracted to lights. Another darker species, with shorter wings marked with two rounded dark brown spots, has been collected at light at Río Piedras.

Rasahus biguttatus (Say) (= *R. hamatus* (F.)) has been collected at Yabucoa and in a grapefruit grove near Río Piedras.

Heza pulchripes, described by Stål from Puerto Rico (Oefv. Vet.—Akad. Forh., 199. 1859), apparently occurs only here, as does **Heza angulifer,** described by Mr. H. G. Barber (1939–389) from Puerto Rico, with

collections made in all parts of the Island. The posterior lobe of the pronotum of both species has four distinct spines.

That of **Zelus subimpressus** Stål, a slender greenish-brown species, has but two small spines. Dr. Richard T. Cotton found egg-clusters, nymphs and adults quite abundant in a grapefruit grove at Vega Alta. The eggs are arranged in a hexagonal mass in regular, alternating rows of four or five on each edge of a hexagon, totaling 52, standing erect surrounded by a reddish-brown adhesive. This Reduviid was listed by Dr. Gundlach as a *Diplodus*.

Zelus longipes (L.) (= *Zelus rubidus* L. & S.), a large black and red species, is by far the most obvious and one of the most common of the assassin bugs in Puerto Rico. It is to be found on knee-to waist-high corn swarming with other insects, or on flowers of botoncillo or wild heliotrope, or wherever insects may be expected to alight within reach of its long, black, sticky front legs. The insects actually observed which it had caught and from which it was sucking the body juices include the lady-beetle (*Cycloneda sanguinea*), larvae of the fleabeetle *Haltica jamaicensis*, the fleabeetle *Diabrotica graminea*, the firefly (beetle) *Lucidiota decorus*, the wasps *Tachytes argentipes* and *Alysia analis*, the house fly (*Musca domestica*), and numerous other kinds of flies, usually smaller. Mr. Thos. H. Jones records the attack on caterpillars of the southern grassworm, *Laphygma frugiperda*, and presumably this bug is limited only by the quickness and relative size of the insect it attempts to capture. The nymphs are less black and more red than the adults, yet despite these reputedly warning colors, *Zelus longipes* is eaten by the kingbird, the petchary and the ani, according to the observations of Dr. Wetmore. It was not found eaten by any lizard, however, nor by the imported Surinam toad, but this may possibly be because it rests for so much on the time on the very tips of vegetation where it would not be readily caught by terrestrial animals. It is especially partial to the fruiting stalks of "rabo de gato" (*Achyranthes indica*). It occurs in all parts of Puerto Rico, and on Mona and Vieques Islands, and was listed by Dr. Gundlach. Under the name *Evagoras tricolor* L. & S., Dr. Stahl records its early presence here.

Mr. H. K. Plank discovered the nymphs of "**Peregrinator biannulipes** (Montr.) a Predator on the Bamboo Powder-Post Beetle in Puerto Rico" (Jour. Ec. Ent., **32** (1): 151. Menasha, February 1939) to be quite abundant at Mayagüez, attacking the adult beetles as they emerged from their galleries in the bamboo, but despite their abundance in the autumn and winter, of little importance in the economic control of the pest. Prof. J. A. Ramos found both nymphs and adults on the walls of a room where cattle feed is stored by the College of Agriculture.

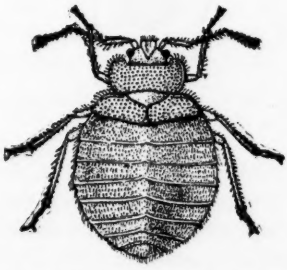
Narvesus caroliniensis Stål, as determined by Mr. H. G. Barber, has been collected in the Luquillo Mountains, and at light at Gurabo.

Nabidae: Damsel Bugs

In "A Monographic Study of the Hemipterous Family Nabidae as it occurs in North America" (Entomologica Americana, 9 (1 & 2): 1–90. Scarsdale, N. Y., 1928) Dr. Halbert M. Harris describes (p. 78, pl. 4) **Metatropiphorus drakei** from Utuado, and notes the occurrence of his **Carthasis gracilis** in Puerto Rico. Dr. Richard T. Cotton collected a single specimen of the latter on grapefruit foliage at Vega Alta in 1917, identifying it as *Carthasis rufonotatus* Champion, of which another synonym is *C. minor* Reuter.

Neogorpis neotropicalis was described by Mr. H. G. Barber (1923–78) from Aibonito and Adjuntas, a slender "sordid-yellow white" bug marked with dilute red, illustrated (1939–397) without additional records.

Only single specimens of **Pagasa fusca** (Stein), **Nabis spinicrus** Reuter and three of **Nabis sordidus** Reuter have been collected in Puerto Rico. Prof. J. A. Ramos found **Nabis capsiformis** Germar on Mona Island, previously known in Puerto Rico only from a collection on string beans at Loíza.



The Bed Bug, *Cimex hemipterus* L. Greatly enlarged. (After Marlatt.)

Cimicidae: Bed Bugs

The tropicosmopolitan bed bug, **Cimex hemipterus** L., occurs in Puerto Rico, and on Mona and Vieques Islands, but not, according to Mr. H. G. Barber (1939–398), the temperate zone species, *Cimex lectularius* L. The control of bed bugs is much simpler since the popularization of DDT has made readily available a really effective insecticide against this pest. To be sure, heavy concentrations must be used for prompt effectiveness,

but 10 per cent DDT in kerosene or benzol will give satisfactory results which even the most thoro applications of kerosene alone or boiling water were not able to obtain previously.

Polyctenidae

While on Vieques Island in 1899, Mr. August Busck collected on a bat specimens of an ectoparasitic bug, **Hesperoctenes fumarius** (Westwood), not since found there or in Puerto Rico.

Anthocoridae: Minute Pirate Bugs

All stages of the pink leaf-sheath bug of sugar-cane, **Lasiochilus divisus** Champion, are found under the older leaf-sheaths of high cane in all parts of the Island, and on Vieques. The smallest nymphs are light pink in

The pink Leaf-Sheath Bug of Sugar-Cane, *Lasiochilus divisus* Champion, twelve times natural size. (Drawn by G. N. Wolcott.)

color, the larger ones a darker pink, and the adults light brown in color. All the Anthocorids are presumed to be predaceous, and many other small insects, such as small mealybugs, psocids, springtails, earwigs, the larvae of the beetle *Telephanus pallidus*, and the mites *Tarsonemus bancrofti*, live under cane leaf-sheaths and might fall prey to these bugs.

Lasiochilus pallidulus Reuter was collected on Vieques Island by Dr. M. D. Leonard, and has also been found, as was **Lasiochilus microps** Champion, at various points in Puerto Rico.

Xylocoris sordidus (Reuter) was found by Dr. Frank E. Lutz on Mona Island, and it also occurs in Puerto Rico.

Adults or nymphs of the little dark brown **Asthenidea picta** (Uhler) were found in abundance in the buds of "majagua" (*Pariti tiliaceum*) at Arecibo in the midsummer of 1922, but with no obvious reason for their being there at all, and certainly not in such numbers. Dr. M. R. Smith (1942–26) notes that "no ants were seen pursuing, attacking or killing these

insects" on scale-infested coffee plants in the mountains back of Mayagüez, which he presumes to be predators on the hemispherical and green scale insects. Prof. J. A. Ramos swept these little bugs from herbage on Mona Island.

Dr. H. L. Dozier (1927–280) first noted that heavy infestations of the thrips on "laurel de la India" (*Ficus nitida*) foliage were to some extent reduced by the attack of the finely pilose **Cardiastethus rugicollis** Champion, which he did not identify as to species, and the black and very shiny **Macrotracheliella laevis** Champion, which had been identified by Dr. C. J. Drake for him as *M. nigra* Parshley. Both have since been found thus associated with thrips on this host, and the former was swept from herbage by Prof. J. A. Ramos on Mona Island.

Mr. H. G. Barber collected **Paratriphleps pallidus** (Reuter) at San Juan, as well as in the Virgin Islands.

Because it was first observed feeding on the contents of the eggs of the corn earworm in the States, what was at that time called *Triphleps*, and is now known as **Orius insidiosus** (Say), is historically the most important of these little black Anthocorid bugs. The first record for Puerto Rico is by Mr. Thos. H. Jones, who observed it on corn, but thought that the aphids (*Aphis maidis* Fitch) and fulgorid nymphs (*Peregrinus maidis* Ashmead), present in abundance, were the insects attacked. Red spiders, on bean foliage, and on cotton leaves at Isabela, have been noted sucked dry. The bugs have also been intercepted on the flowers of "margarita" (*Bidens pilosa*) at Guayama, on *Pluchea purpurascens* at Pt. Cangrejos, on squash leaves and under the leaf-sheaths of sugar-cane, in all of which habitats they should find an abundance of small insects on which to feed, so many indeed that it is difficult to be specific as to those actually eaten.

Miridae: Plant Bugs

One of the largest of the plant bugs (Miridae or Capsidae), easily recognized by the prominent dark spots near the humeral angles of the pronotum, is **Collaria oleosa** (Distant), first recorded from Puerto Rico as a *Nabidea*, present in large numbers on Pat McLain's ill-fated low-land rice plantation at Canóvanas. It has also been noted on malojillo, and on Solanaceous plants and others in the more humid parts of the Island.

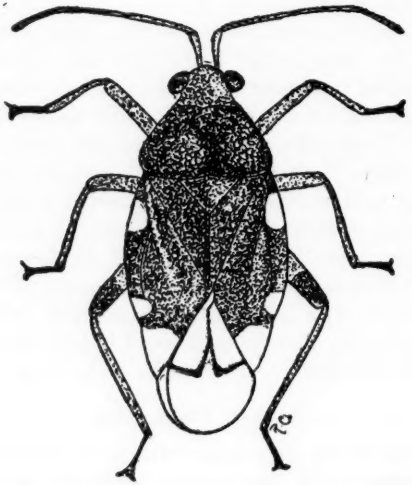
Creontiades rubrinervis (Stål) inhabits the same type of swampy malojillo meadow environment, but Prof. J. A. Ramos swept it from grass on Mona Island, a much dryer region than any from which it is recorded in Puerto Rico.

What Dr. Reece I. Sailer thinks must be "without any question" **Trigonotylus brevipes** Jakovlev occurs in great abundance on Bermuda grass.

Polymerus cuneatus Distant, identified by Mr. W. L. McAtee as a

Poecilocytus and thus reported in "Insectae Portoricensis" (1923–245), may at times be very abundant on the foliage of beans, and less so on the leaves of tomato, tobacco, carrots, dahlia, cotton, "blero" (*Amaranthus* spp.), the wild "margarita" (*Bidens pilosa*) and even on the leaves of sugar-cane. Mostly black or very dark brown in color, it has a prominent yellow spot on the scutellum, and is comparatively short and plump. It occurs in all parts of the Island and Prof. J. A. Ramos has swept it from weeds on Mona Island.

A much smaller little black bug with narrowly banded transparent wings, found on weeds in a cane field, in malojillo meadows and on cohítre grass in the mountains, early identified by Mr. E. H. Gibson as *Bolbosia deflexa* Uhler MS, Dr. R. I. Sailer states is **Pycnoderes heidemanni** Reuter.



The black Squash Mirid, *Pycnoderes quadrimaculatus* Guérin-Méneville, ten times natural size. (Drawn by R. T. Cotton.)

The small black squash bug, as Dr. Richard T. Cotton (1918–306) called **Pycnoderes quadrimaculatus** Guérin-Méneville (= *P. incurvus* Distant), tends to become a serious pest on that vegetable. It also may occur on cucumber, pumpkin and on "blero" and generally on weeds in gardens. Indeed, it is so common at times as to form an item in the food of the crested lizard. Most recently, Dr. Luis F. Martorell found it on beans on Mona Island.

Dr. Gundlach gives the name *Lygus sallei* Stål for what has more recently

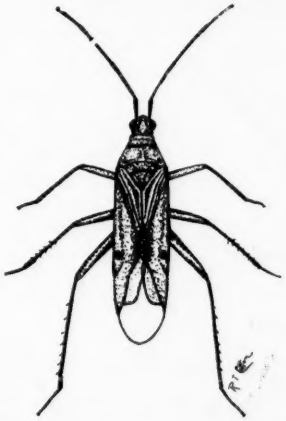
been identified as **Lygus apicalis** Fieber, a common little, light green bug found on weeds, specifically on *Pluchea purpurascens* at Pt. Cangrejos, on carrots, and on tender growth of *Inga laurina* at Lares. More recently it has been collected at light on Mona Island.

Lygus fasciatus Reuter on wild daisy or "margarita" (*Bidens pilosa*), and **Lygus olivaceous** Reuter on pomarrosa flowers (*Eugenia jambos*) have been collected once.

Cyrtocapsus caligneus Stål has been found on squash and sweet potato leaves.

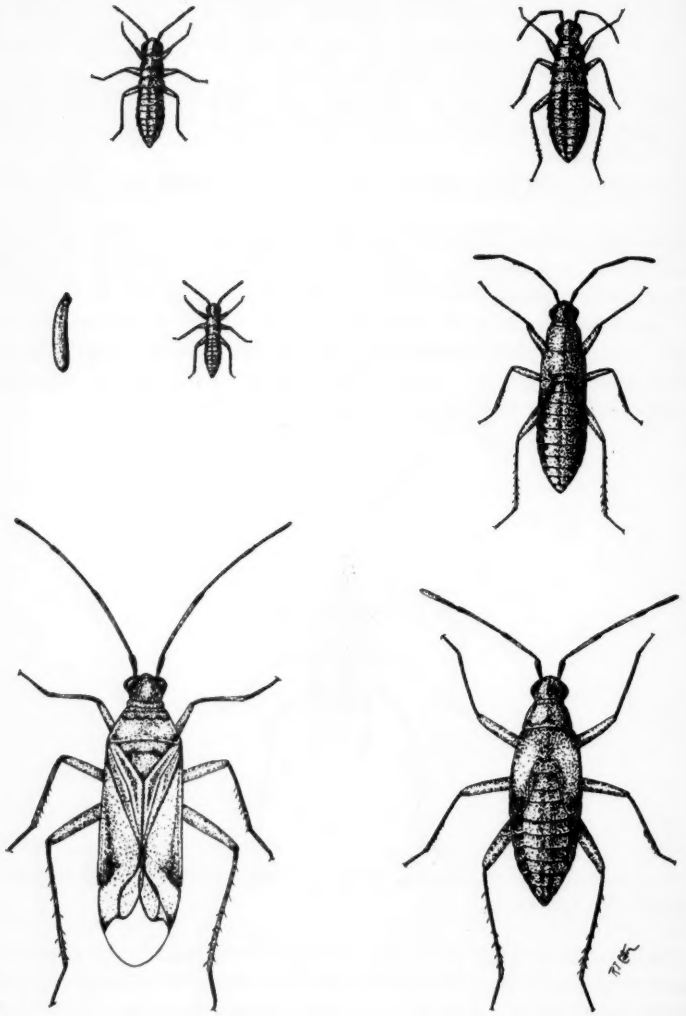
Hyaloides vitreus (Distant) has been found on the leaves of "maga" (*Montezuma speciosissima*) and of "guanábana" (*Annona muricata*).

Paracarnus cubanus Bruner, as recently identified by Mr. H. G. Barber, was found by Dr. Luis F. Martorell on the underside of the leaves of "capá blanco" (*Petitia domingensis*) at San Lorenzo, of "moral" (*Cordia sulcata*) and "emajagua" (*Pariti tiliaceum*) at Cayey, and of introduced ash (*Fraxinus* sp.) at El Verde, in nurseries of these trees.



The Tomato Mirid, *Macrolophus praeclarus* (Distant), fifteen times natural size. (Drawn by R. T. Cotton.)

The two Mirid bugs which Dr. Richard T. Cotton (1917–113 to 119) found so abundant on tobacco, described by Mr. E. H. Gibson (Canadian Entomologist, **49** (6): 218–19. London, Ontario, June 1917) as *Dicyphus prasinus* and *Dicyphus luridus*, have since been re-identified and are known as **Macrolophus praeclarus** (Distant) and **Cyrtopeltis varians** (Distant). The former, slighter and more slender, has "a large irregular fuscuous spot near the costal margin of each wing-cover and midway between base and



The large Tobacco Suck-Fly, *Cyrtopeltis varians* (Distant): all stages, egg to adult. About fifteen times natural size. (Drawn by R. T. Cotton.)

apex", and is not so abundant on tobacco as on tomato. The latter, of which Dr. Cotton made a drawing of all stages and named the "Large Tobacco Suck-Fly", is at times so abundant on the few tobacco plants left in the field for seed as to seriously affect the amount of seed produced and the germination of what does mature. Adults have also been found on *Adenoropium gossypifolium* and *Amaranthus spinosus*, and in a grapefruit grove at Añasco.

Macrolophus separatus Uhler, as determined by Mr. H. G. Barber, has been collected on tobacco at Juana Díaz, and **Cyrtopeltis tenuis** Reuter on tomato at Bayamón.

Mr. H. G. Barber has identified individual collections intercepted by the Federal Plant Quarantine Inspectors as follows:

Halticus nigricornis? Reuter, on tomatoes at Jayuya,
Hemisphaerodella mirabilis Reuter, on pineapple at Lajas,
Reuteroscopus uvidus Distant, on alfalfa at Arecibo, and
Psallus politus Uhler, on grass.

On the foliage of orange or grapefruit have been plant bugs identified as *Neofurius* sp. ?, apparently a new species of *Fucus* Distant, and *Chlamydatus* sp., near *suavis* Reuter.

To these records, Prof. J. A. Ramos adds:
Phytocoris sp., from Vieques Island,
Eustictus sp., at Ponce and Mayagüez,
Sixenotus sp., on cohítre at Consumo, and
Halticus sp., on sweet potato at Mayagüez.

Cryptostemmatidae

The pale, chocolate-brown, somewhat shining **Ceratocombus vagans** McAtee & Malloch has been found on dead leaves at Río Piedras and Jayuya.

Hydrometridae: Marsh-Treaders

Hydrometra consimilis, described by Mr. H. G. Barber (1923–9) from Coamo Springs, has since been collected at Añasco, Lajas and Hormigueros.

Gerridae: Water Striders

The relatively short and broad **Rheumatobates imitator** Uhler has been found on the surface of the Guayabal reservoir.

Metrobates laudatus Drake & Harris was described (Revista Entomología, **7** (4): 357. Rio de Janeiro, October 1937) from apterous male water striders collected at Juana Díaz and Río Piedras. It has entirely black antennae.

The more elongate, glistening dark brown or black **Limnogonus franciscanus** Stål, its pronotum margined with yellow, is the common water strider to be found in bodies of water everywhere in Puerto Rico and on Mona, Culebra and Vieques Islands. Dr. Stahl's name of *Gerris marginatus* Guérin, Dr. Gundlach's of *Limnotrechus*, and that in Mr. Barber's preliminary list of *Tenagogonus guerini* L. & S., as well as that given to Van Zwaluwenburg by Mr. O. Heidemann of *T.* (*Limnometra*) *quadrilineatus* Champion, all refer to the same common insect. Dr. Wetmore found that, of aquatic birds, only the green heron had eaten it.

The dull, dark **Gerris remigis** Say has been collected at Quebradillas and at Ponce, and **Gerris cariniventris** Champion in the mountains.

Veliidae

The pools or "charcas" of the Isabela region are an especially favored habitat for the little black Veliid bugs, of which Dr. Wetmore found that both the killdeer and the spotted sandpiper had eaten. **Microvelia capitata** Guérin-Méneville, **Microvelia paludicola** (Champion), **Microvelia pulchella** Westwood and **Microvelia robusta** Uhler are the species found at the margins of streams and pools in all parts of the Island, the latter occurring also on Mona. Dr. Gundlach listed *Microvelia pulchella*, but many of the more recent collections have been made by Dr. W. A. Hoffman.

Rhagovelia plumbea Uhler occurs in xerophytic Puerto Rico, having been found at Boquerón and at Ponce Playa; the common species is **Rhagovelia collaris** Burmeister, found also on the south coast, but more often in the mountains: at Maricao and on El Yunque.

Saldidae: Shore Bugs

Pentacora sphacelata (Uhler) has been collected near the shore of Puerto Rico.

Pentacora signoreti (Guérin-Méneville) has been found around the margins of salt-water pools on the beaches near Arecibo, Mayagüez, Boquerón and Maunabo, and is very abundant in the specialized environment in which it only occurs.

Saldula pallipes (F.) has been collected at Ensenada, and **Saldula interstitialis** Say was found abundant at Guánica Lagoon by Prof. J. A. Ramos.

Micracanthia sulcata, described by Mr. H. G. Barber (1939–415), the type from Coamo, others on weeds at Ciales, has been found in abundance by Prof. J. A. Ramos at Cartagena Lagoon. A single small specimen, identified by Mr. Barber as doubtfully *Micracanthia humilis* (Say), is from San Juan.

Pleidae

Dr. Wetmore found that the water thrush, the sandpiper, the gallinule and the black swift had eaten some of the little thick-bodied bugs (Pleidae) described by Mr. H. G. Barber (1923–10 to 11) as **Plea puella** and **Plea punctifer**, of which he later published (1939–418 and 419) illustrations. Dr. Stuart T. Danforth found that they had been eaten by the little blue heron and that they were especially abundant on the shores of Cartagena Lagoon, where he conducted his first extensive ornithological observations.

Notonectidae: Back Swimmers

Dr. Wetmore found fragments of back swimmers in the stomachs of sandpipers and of the ani, and Dr. Danforth, of the green heron and the yellow-shouldered blackbird. **Notonecta indica,** the original name given by Linnaeus in 1771, is still correct for the species found in all parts of Puerto Rico, from El Yunque to Cartagena Lagoon. It has an extensive distribution, found also in St. Thomas and St. Croix, but not recorded from Vieques, Culebra or Mona.

Buenoa macropthalma (Fieber) lives in mountainous streams in Puerto Rico. It "occurs in two forms with both sexes represented in each, one for the most part black, the other entirely pale, the latter in all of the specimens seen having the hind wings abbreviated".

Buenoa femoralis (Fieber), "pale cinereous, hyaline" 8.0 – 8.5 mm. long, was described from Puerto Rico (Rhynchota, 59, 1851) and is also found on Mona Island.

Buenoa pallipes (F.), smaller and lighter-colored, occurs thruout Mexico and the West Indies, with records of collection in both Mona and Culebra Islands. A fourth undescribed species occurs in Puerto Rico, close to *B. albida* Champion.

Naucoridae: Water Creepers

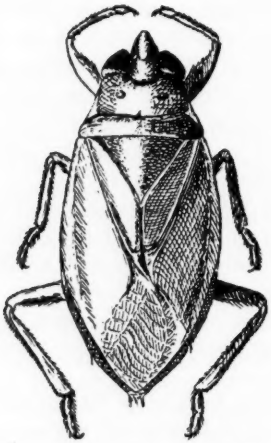
Pelocoris femorata (Palisot de Beauvois) is the only species of Naucoridae found in Puerto Rico, all records of collection being from the lagoons in the southwestern corner of the Island. In observing the "Birds of the Cartagena Lagoon" (Jour. Dept. Agr. P. R., **10** (1): 1–136, fig. 45, ref. 41. San Juan, January 1926), Dr. Stuart R. Danforth notes that the nymphs, locally known as "cucarachas de agua", inflict a painful sting on man. He found that 94% of the stomach contents of a gull-billed tern which he examined consisted of this insect, and that nymphs or adults formed a large fraction of the food of the grebe, the snowy egret, both herons, the pectoral sandpiper, the ani and the yellow-shouldered blackbird.

Nepidae: Water Scorpions

Ranatra insulata was described by Mr. H. G. Barber (1939–423) from specimens collected by Dr. Danforth at Las Marías. Prof. J. A. Ramos has found it at Mayagüez and at Faro de Cabo Rojo. It is extremely slender and elongate, the body alone being 35.0 mm. long.

Belostomatidae: Electric Light Bugs

The smaller and more common of the electric light bugs is **Belostoma boscii** (Lepeletier & Serville) (= *Zaitha anura* H. S.), averaging about an



Belostoma fuscigera Stål, an Hispaniolan Electric Light Bug, not known to occur in Puerto Rico, twice natural size. (Drawn by Fritz Maximilien.)

inch in length. Dr. Gundlach reports it "en las lagunas", before the day of electric lights, but most of the collections made since have been at light. Dr. Danforth found that it had been eaten by the blue heron, and Mrs. Raquel Dexter by the introduced toad, *Bufo marinus*. Indeed, during the years when the toad was most abundant, no collection of this bug was made by entomologists.

The common large electric light bug, **Lethocerus annulipes** (Herrich-Schaeffer), was reported by Drs. Gundlach and Stahl under the name *Belostoma medium* Guérin. It averages considerably more than two inches in length, too large, it would seem to us, to be easily swallowed whole by the introduced toad. It seems no more abundant now, since the introduction of *Bufo marinus* furnished an abundance of pollywog food for its

nymphs and adults, than before this addition to the Island's fauna. Birds have less difficulty in eating it, and Dr. Danforth found it in the stomach contents of both herons, the greater yellow-legs, lesser scaup and Allen's and ruddy ducks. On August 18, 1948, Mr. Mario E. Pérez found one adult in the alimentary tract of the common bullfrog, as reported in his paper on "The Food of *Rana catesbiana* Shaw in Puerto Rico" (Jour. Ec. Ent., *in press*), introduced here in 1935 and now audibly abundant generally along the coast. That the adult electric light bug is eaten by the frog is no more than just retribution for all the pollywogs eaten by its aquatic larvae.

A single specimen of **Belostoma minor** Duf. has been found in Guánica Lagoon.

Lethocerus del-pontei De Carlo is reported from Puerto Rico by Mr., Carl Cummings ("The Giant Water Bugs, Belostomidae—Hemiptera", Sci. Bul. Univ. Kansas, **21** (2): 197–219, pl. 2. Lawrence, March 1933), but is presumably rare, and difficult to distinguish from *Lethocerus annulipes*.

Corixidae: Water Boatmen

Trichocorixa reticulata (Guérin-Méneville), reported by Dr. Gundlach as a *Corixa*, is an important item in the food of many shore and aquatic birds in Puerto Rico, Dr. Wetmore finding that it constituted 57.5% of the stomach contents of the lesser yellow-legs collected at Cabo Rojo, and over 50% of the black-necked stilt. He also found that it had been eaten by the lesser scaup duck, the killdeer, sandpipers, Wilson's snipe, and ani, woodpecker and grasshopper sparrow, and Dr. Danforth by the gull-billed tern, snowy egret, white-rumped sandpiper and the ani. Most of the collections of the insect by entomologists have been made in the south-western corner of the Island, but it has been found in a jasmin flower at Bayamón, and Dr. W. A. Hoffman in the swimming pool at El Semil, near Villalba.

On Mona Island, Prof. J. A. Ramos (1947–23) found **Trichocorixa verticalis** (Fieber), as identified by Dr. Reece I. Sailer, "abundantly in several small pools of stagnant water along Sardinera Beach, April 16 and August 11–31, 1944. This is a North American species which has not yet been found in Puerto Rico itself. It can be easily distinguished from other species by its robust form and the large frontal depression of the males."

Prof. J. A. Ramos also has numerous specimens collected at light at Mayagüez, Barranquitas and Juana Díaz identified by Mr. H. G. Barber as a species of **Arctocorixa**.

Dr. H. B. Hungerford identifies specimens from Mayagüez as **Centrocorisa kollari** Fieber.

Condensed Index of Insex*

By C. R. Hartzell

All bugs
Have mugs
Like Thugs!

At every chance
Ants
Get in pants!

Moths
Love cloths!

Lice
Aren't nice!

Termites
Work nights!

Fleas?
Jeez!

Comejens
Have no fren's!

Never tease
Bees!

Always mistreat a
Mosqueata
And always bang a
Changa!

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* An index for the four numbers of this volume will appear at the end of the last number.